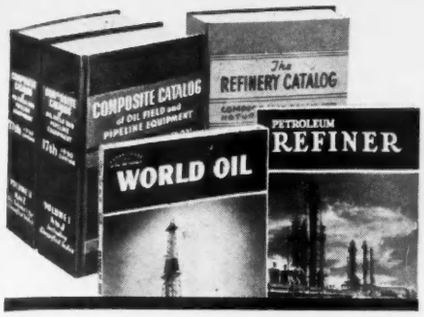


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**WORLD OIL and The COMPOSITE CATALOG**
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**PETROLEUM REFINER and The REFINERY CATALOG**
**for the refining-natural gasoline industry**

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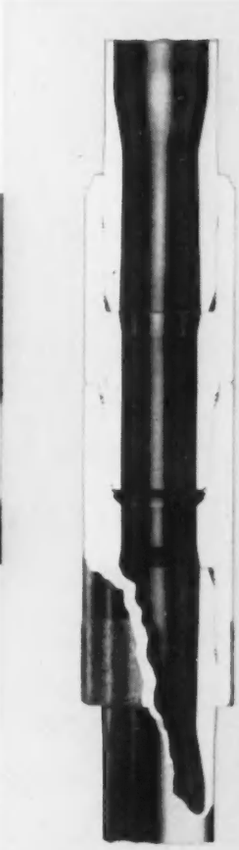
# Current Outlook Section

L. J. LOGAN, SECTION EDITOR

**WORLD OIL**


**REED**
*Super Shrink-Grip*
**TOOL JOINTS**

***"I'm convinced that they keep down drill string costs!"***



**. . . says Fred E. Stickle, superintendent for Stickle Drilling Company of Tulsa, Wichita and Great Bend.**

"In my opinion, tool joints must satisfy three requirements: they must be strong and safe, they must be long lasting, and they must be easy and economical to replace. **REED** Super Shrink-Grip Tool Joints meet all these requirements so well that I'm using them on my rigs."

**REED ROLLER BIT COMPANY**

HOUSTON 1, TEXAS

THE MARK OF QUALITY

Gulf Coast, Mid-Continent, Rocky Mountain and Canadian Distributor for Martin-Decker Products

# Offshore Gravity Surveys

HOUSTON

PATTON BEACH STATION

LIVERPOOL STATION

Red Baseline

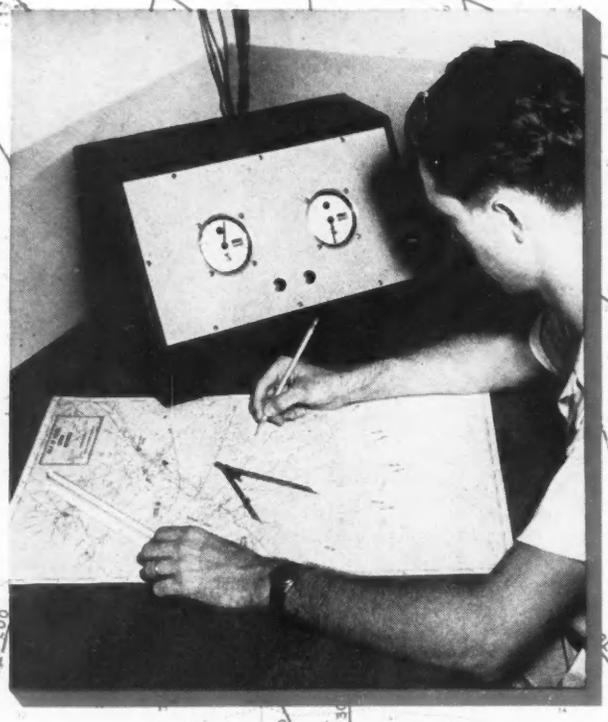
GALVESTON

Green Baseline

SARGENT STATION

## Now offered by SSC's GRAVITY DIVISION

The meticulous control of gravity measurements has little economic value when the station locations are subject to large errors.



## Using LORAC

**SSC's Radio Surveying and Navigation System—**

**Furnish accurate locations at distances of 100 miles or greater for Offshore GRAVITY METER Stations.**

**The remarkable accuracy of LORAC has been proven in actual field work.**

## Seismograph Service Corporation

Seismic Surveys — Gravity Surveys — Pilot Surveys — Lorac

TULSA, OKLAHOMA, U.S.A.

# Looking Ahead

DRILLING CONTRACTING INDUSTRY is offered good opportunity in prospect for continued active field development. Assuming completion of 43,400 wells annually over next five years, total of 217,000 wells would be drilled. At estimated average cost of $77,000 per well, the oil industry would spend nearly $17 billions for this drilling of wells.

U. S. CRUDE PRODUCTION is due to increase further and set new record in October, after averaging over 6,275,000 barrels daily in September. Texas allowable was raised 5541 barrels daily, and will rise an additional 10,000 barrels daily each week through completions of new wells. These increases will more than offset slight reduction in Louisiana allowable for October.

FLAT INCREASE OF 25 CENTS PER HOUR in wage rates of West Coast oil workers is objective of Oil Workers International Union (CIO), using September 1, 1951, rates as base. Negotiations with West Coast companies are due to be opened in early October. OWIU national policy makers recently made it mandatory on locals of union to accept no less than 25-cents increase in negotiations with oil companies.

THREAT OF SHORTAGE OF HEATING OILS in New England during coming winter still is talked seriously. Large exports have caused some anxiety in this connection. Price control regulations are blamed for forcing jobbers to ship stocks abroad. Situation is being investigated in Congress.

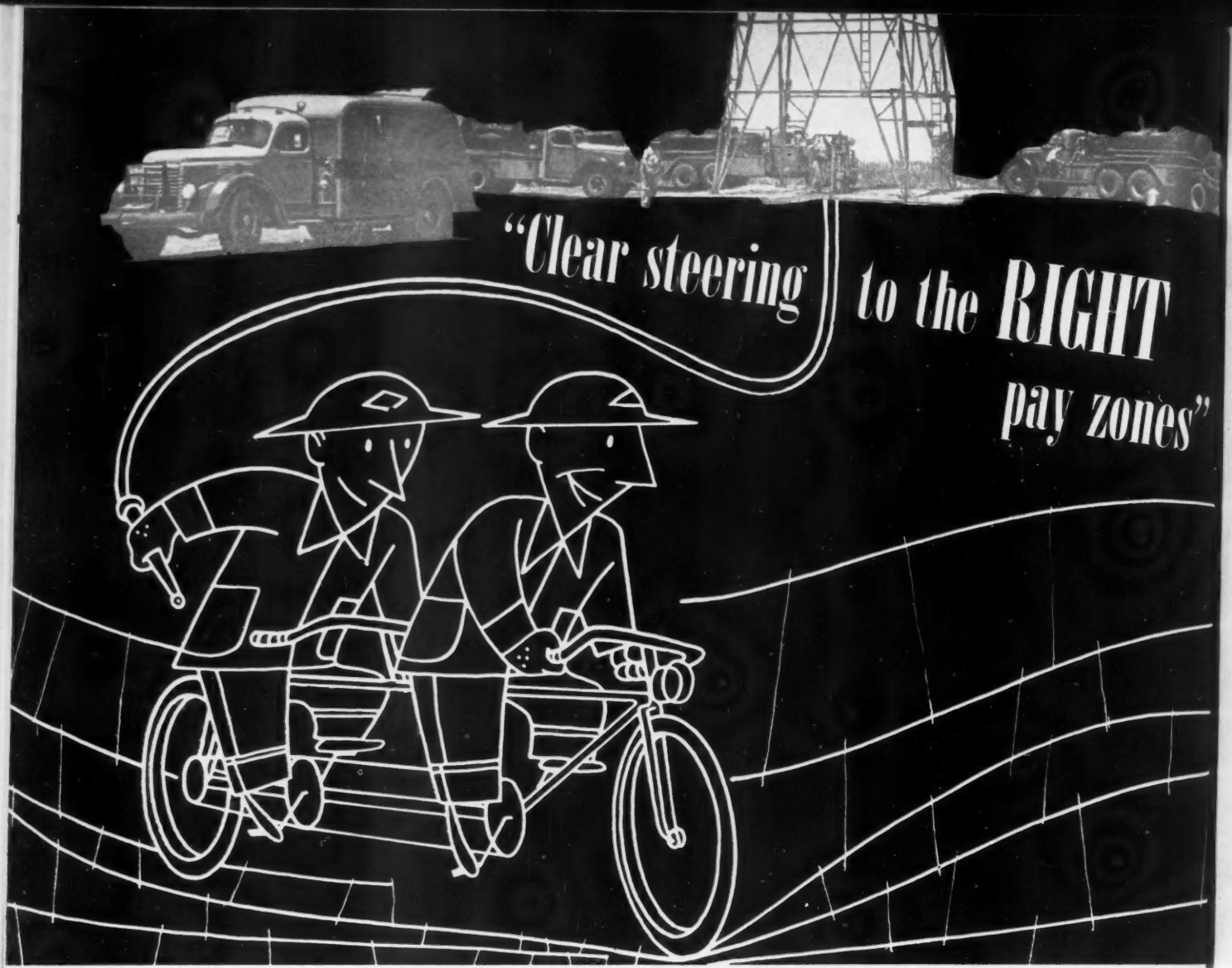
LITIGATION MAY RESULT from purchases of oil from Iranian government. Anglo-Iranian Oil Company at mid-September placed advertisements in nine newspapers, including four in New York, warning that if anyone should make any deal with Iran for crude or products, the "company will take all such action as may be necessary to protect its rights in any country."

INDUSTRY LIKELY will make wide use of new technique of circulating gas rather than drilling fluid in completing wells. It has become standard practice in San Juan Basin, (WORLD OIL, Aug. 1951, p. 128). Experimental work on the method is being done in Mid-Continent and West Coast areas where it would be good for certain drilling-in and workover operations.

WITH THE STEEL INDUSTRY using scrap metal at the rate of 76,000 tons daily, an additional 5 million tons of scrap is required annually if the industry is to maintain a goal of 117,500,000 ingot tons of steel a year. The oil industry is being urged by steel men to increase its scrap cleanup and salvage work in order to help meet this quota.

ADDITIONAL U. S. PETROLEUM REFINING CAPACITY "cannot be built too soon or too fast," National Petroleum Association was told by Rear Adm. B. B. Biggs, the military's top petroleum official. He urged greater flexibility in refinery yields as well as sharply higher capacity.

WATER-FLOODING OF SALEM FIELD, Illinois, following unitization in 1950, is expected to cause increase in production around end of 1951 and eventually to add 200 million barrels to field's output.




## 33% MORE OIL after Dowell Selective Acidizing than after regular acidizing

Efficient acidizing is putting the acid in the zones that pay. That's the purpose of Dowell Selective Acidizing.

The Electric Pilot has been designed to enable Dowell engineers to steer the acid into the oil-bearing zones instead of letting the acid follow the path of least resistance. Dowell Selective Acidizing pays . . . as was proved in this case:

A new well was being treated for the first time. The microlog indicated two permeable zones in the well. After selective acidizing of these two pay zones with the accurate Dowell Electric Pilot, the completed well produced 33% more oil than nearby wells that were treated with the same amount of acid in the conventional manner.

Selective acidizing is useful in most old wells, particularly those with residual oil to be recovered from tight sections; those with high gas-oil ratios, or intermediate water zones; and those plugged back from bottom water or deepened to new pay zones. It is of value for new wells with saturated zones of varying permeability and those with a change of formation within the open hole.

Call the nearest Dowell office and ask for additional information about selective acidizing and the other Dowell Electric Pilot Services promptly available to you.

**DOWELL INCORPORATED**
TULSA 1, OKLAHOMA
Subsidiary of The Dow Chemical Company

# DOWELL

*SELECTIVE ACIDIZING*

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale Removal for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for Corrosion Control and Bulk Inhibited Hydrochloric Acid.

*"First in Acidizing . . . since 1932"*

*Look to* **DOWELL**

FOR OIL INDUSTRY CHEMICAL SERVICE

# TRUMANITES SMARTER?

A RECENT Gallup Poll indicated that a cross-section of the American people thought the Democrats were smarter than the Republicans in presenting their case to the public.

Probably the administration in power (having been for years a Democrat we find it difficult to stomach calling Socialists Democrats) has done a better job with a large segment of the American people. This could be partly due to being in power and partly due to the bull-in-the-china-shop characteristics of some Republican leaders who, with certain other national legislators, including the senior senator from our native State of Texas, ought to be retired to grass permanently.

But we doubt if there has ever been as complete a national "low" on genuine intelligence as is chronically displayed by the Truman administration. If real brains were at a premium these days, no premium hunter would waste his time on most of the group surrounding the President.

The degree of real intelligence of the administration is to be found in the muddling, murderous, Korean policy —a kind of policy not unknown to modern history because it had at least its approach in the Chamberlain-Munich episode.

• • •

IS IT IMAGINABLE that the expert of all experts on the Japanese, or for that matter, the Asiatic question, not even be consulted by the former bankrupt haberdasher from Missouri or his pal, Acheson, in the final moments of the Japanese negotiations? Yes, it is just as imaginable as many of the unintelligent things the administration has done.

Fortunate it is for the American people that the cheap anger of Harry Truman reacted with violence against MacArthur *after* the General had helped in at *least* the first drafts of the Japanese treaty.

On the International scale, where the unscrupulousness of the Communists has matched the domestic unscrupulousness of so many administration leaders, the Communists seem constantly to be pushing us into untenable positions.

But they have made one major mistake. The American people, slow to believe the worst, slow to anger, have learned one big lesson which all the Communists in the U. S. and all their influences, wherever placed, can never erase.

• • •

RUSSIAN LEADERS have done more than a good job of selling Communists or would-be Communists that a Capitalistic state cannot long exist in the world with a Communistic state. One or the other must die, they have taught.

What the Russian Red leaders have done, in addition to teaching Communistically inclined nations that the two ideologies cannot live together in peace, is to teach the same lesson to Americans and other non-Communists throughout the world. And it was a sad day for Russia when America learned her lesson.

So be it. There can be no compromise—here at home in America or elsewhere.

America is arming. This is the third time she has armed against aggression this century. Russia, no doubt, is arming, too, but Slavic slavery does not have the ability to win in the final all-out struggle.

The war in Korea has proven that mass manpower is not enough. The last two World Wars, though marked with the blood of millions of men, were won in the factories of America and England. Russia has transferred to her territory large amounts of manufacturing equipment seized in Germany—for the most part already heavily over-used. In Russia these German tools of production may seem wonderful to a people who lost most of what they had in the way of such equipment in the early days of the German-Russian struggle. Much of what was left, hurriedly moved far to the East, is already obsoleted by years, but had not American equipment gone to the aid of the Russians in World War II, Stalin and his big-mouthed stooges in the United Nations would be fast moulding into the myth that was Hitler, Goebbels (he was a hate-spreader, too), and their ilk.

Yes—it was a sad day for Russia when she taught us that our form or theirs must be destroyed.

Ray L. Dudley

# FOR SAFE, LOW-COST HOLE ENLARGEMENT

. . . no other tool is equal to the BAKER ROTARY WALL SCRAPER.– When it is desirable to enlarge the diameter of an open hole to an extent considerably greater than the diameter of the casing, you can depend upon this strong, safe Wall Scraper with blades which open positively when pump pressure is applied. The uncased hole *can be enlarged at any point,* and by changing to progressively larger sizes of blades, an amazingly increased diameter can be secured. Example: No. 6 size Scraper can be run safely through 9⅝" API casing, then will ream from a minimum of 9¼ inches to maximum of 19 inches by changing to increasingly larger sizes of blades.

## RUGGED BLADES CLOSE SAFELY

Baker Wall Scraper blades have extra-long vertical cutting edges which prevent any tendency to "corkscrew" and insure scraping the maximum footage of full-gauge hole. And, when the Scraper is to be removed from the hole, pumps are shut down and a strong spring aids in closing blades into body. These blades are made from alloy steel forgings, and their cutting surfaces are hardfaced and set with tungsten carbide inserts to insure long cutting life.

## MANY IMPORTANT USES

THE BAKER ROTARY WALL SCRAPER is extremely versatile and is successfully and economically used for many worthwhile applications, a few of which are shown below. It will pay you to learn all about the Baker Rotary Wall Scraper (Product No. 500-D) from your BAKER (or Composite) CATALOG, or better yet, ask the Baker representative in your area for helpful suggestions as to how this efficient tool will fit right into your drilling program.

**BAKER**

ROTARY HYDRAULIC EXPANSION

**WALL SCRAPER**

PRODUCT NO. 500-D

Fig. 1

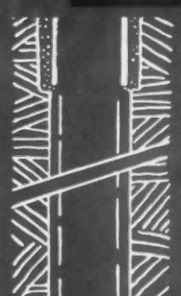


Fig. 2

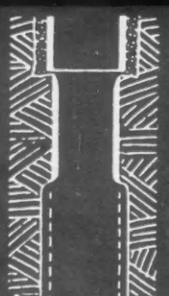


Fig. 3

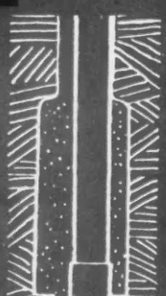


Fig. 4

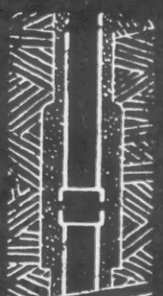


Fig. 5

Fig. 6

**These typical uses illustrate a few of the many worthwhile applications of the Baker Rotary Wall Scraper.**

**Figure 1—WATER SHUT-OFF TESTS are made after rat-holing below the shoe, "wall scraping" for a vertical distance of 5 feet or more to the gauge of the original hole (or slightly beyond). Figure 2—ENLARGING HOLE TO SET CASING OR LINER with maximum ease and safety. Figure 3—REMOVING MUD SHEATH from the face of the formation to permit cement to bond with original formation. This same procedure is used to scrape the face of the oil sand to increase production. Figure 4—BOTTLENECKING to insure complete encasement of the shoe joint with cement; also to minimize hazard of channeling at this vital point. Figure 5—ENLARGING HOLE FOR C.P. JOB—showing "bottlenecked" section with casing or liner serving as water string above, and oil string below, the cementing point. Figure 6—GRAVEL PACKING is easily and effectively performed when the hole has been enlarged with a Baker Rotary Wall Scraper.**

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**OIL TOOLS, INC.**

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# The Changing Panorama

## Government Taxes Tax Imagination

Jones and Laughlin Steel Corporation's figures for the first half of 1951 showed the company made a little more for the same period this year than last because they were able to sell more steel.

In fact, J&L sold a *lot* more—but made only a *little* more. And the reason the company didn't do better is *taxes*. At present tax rates it had to provide about $16 million *more* in the first half of this year than it did in the first half of 1950 to meet its federal income taxes.

Here are the figures!

Last year, for the first half, J&L's income before providing for federal taxes was $26,292,000. Taxes were estimated at $9,977,000, so *net* income was $16,315,000. In the first half of 1951 the company's income before taxes was $43,245,000 and this substantial increase was due to the fact that J&L sold about $63 million more steel. But the federal tax on this income is $26,111,000, which leaves the company with $17,134,000.

In brief, J&L sold all the steel it could. It increased sales by $63 million but made only $819,000 more than it did in the first half of last year. But during the past 12 months the company spent heavily for new tools for production and must continue to spend at a high rate to complete its program.

Although J&L's income after all expenses and charges, except federal income taxes, was up $16,953,000, or about 64 percent, largely because of did over $63 million more business, its federal income taxes were up $16,134,000 or over 161 percent.

Federal income tax paid by Socony-Vacuum Oil Company, Inc., for 1950 ($43,400,000) amounted to $1000 for each employe of the company in the U. S., according to an article in the current issue of *The Flying Red Horse*, employes' publication.

Socony-Vacuum's income tax "bite" equalled all dividends paid by the company in 1950, and the article asserts "that was only the beginning." It continues: "Uncle Sam collected about $56 million more out of the $200 million paid in salaries and wages to Flying Red Horse employes in the U. S. Stockholders paid an estimated $14 million in taxes on their dividends from the company. In addition, the company collected $180 million in excise and sales taxes on gasoline and other petroleum products, and passed this money along to federal, state, and local governments.

"Thus the governments collected over $330 million all told directly from Socony-Vacuum and its stockholders and employes. This was $156 million more than our employes and stockholders had left in their hands."

The article points to probable expansion of "already inflated" government budgets and concludes: "The country more than ever needs profitable big business."

## Roll Some Heads and Your Taxes Will Fall

HOPING TO KEEP the burden of federal taxation from growing unbearable, Americans from all sections of the country have united in a strong movement to put a constitutional limit of 25 percent on federal taxes on personal, corporation, and inheritance taxes.

Legislatures of 24 states have petitioned Congress to submit such a constitutional amendment to the states for ratification, and there is hope that the remainder of the required 32 states may take similar action before long. The proposed amendment would then have to be ratified by 36 states to become effective.

Although this movement is commendable, it represents trying to do an essential thing the hard way. The plan seeks to stop wasteful government spending by controlling free-spending congressmen, whereas the American people could stop the waste more directly and more certainly by ousting the wasteful spenders and replacing them with congressmen who would voluntarily hold down spending and taxes.

First possibility that this amendment would be useless lies in proposals that the limitation could be suspended during war. Technically, World War II was dragged out for years after hostilities ended, in order to preserve war powers for the "Fair Deal." Rather than be cramped by lack of tax revenue, any administration could similarly suspend the taxing limit indefinitely by constantly maintaining a "national emergency."

Second possibility of ineffectiveness of a constitutional limit of 25 percent on federal taxes on income lies in government spending in excess of government revenue. Not being able to raise enough funds from taxes, the government could simply do what it has been doing for 20 years under the New Deal and the Fair Deal—spending beyond its income and adding the deficit to the constantly growing and now huge national debt. Using what amounts to printing press creation of new money, instead of borrowing already existing work-created money, the government is not handicapped by any limits to its possible spending. What cannot be raised by taxes is raised nevertheless, at the taxpayers' expense, by passing billions of new "bogus" dollars into the money supply, cheapening the dollars that the taxpayer holds in his savings account, insurance policy, pension fund, or in bonds. Already, excessive deficit financing has wiped out half the prewar value of such taxpayer properties as those mentioned.

A limit on the tax rate, to be effective, would have to be accompanied by an unviolated constitutional ceiling on the national debt or in effect an eventual ban on government borrowing and a requirement for a perennially balanced budget.

Ceilings on both the income tax rate and the national debt should make excessive government spending and taxing more difficult than now. But don't underestimate the ingenuity of "big government." If necessary, rather than reduce spending, it could resort to many new taxes of other kinds and increase existing taxes other than income taxes. The taxpayer could be weighted down beyond his capacity, for example, by heavy taxes on sales, services and transactions and license fees to sell goods, perform services, or do other things.

Groaning under a tax burden that grows ever heavier, the American taxpayers need to do something besides invoking a constitutional amendment, and if they did it, they would not need the amendment. The necessary fundamental action is to elect and maintain in office men who can and will put a stop to wasteful, socialistic, and unnecessary government spending.

*Report from the Observatory*

# IRANIAN CRUDE LOSS OFFSET

By RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

WHILE the loss of Iranian crude has been reflected in some shifts in operations in the U. S., no major influence has been felt. As a result, the economic outlook of the domestic industry has shown comparatively little change during the past month. The gap in world crude supply has been filled largely by sharply mounting output in Kuwait and Saudi Arabia. This necessitated a decline in U. S. petroleum imports and a rise in exports which have been offset by continued record levels of crude production and refinery operations.

World demand trends during the immediate future months will have an unusually important bearing on the industry's statistical position and will deserve close watching, particularly since a serious oversupply is possible. An extremely cold winter in Europe or North America would cause some strain on supply channels, with residual fuel oil the most vulnerable product. However, the U. S. Foreign Petroleum Supply Committee has been successful in finding additional offsetting crude production and refinery capacity and in distributing supply to areas formerly dependent on Iranian output. The margin of world supply over demand has not been depleted and the long-ranged prospects are for the rate of supply to increase faster than consumption.

*Anticipated continued increases in production of leading areas abroad and the steady expansion of European refinery capacity indicate a diminishing need for U. S. petroleum exports in world trade, even if Iran's oil is permanently lost to Western Nations.*

An appreciable decline in the daily import rate from 974,900 barrels in mid-May to 601,700 barrels in mid-September, together with rising exports which have continued to increase above the 470,000-barrel a day rate recorded for July, have been important factors in keeping the domestic industry's inventory position from getting entirely too large. Even with this aid, which may not exist over a long period, above-ground inventories remain high though somewhat improved from mid-summer. The 5541-barrel per day increase in the Texas October allowable production, however, points to either a further slight increase in present record refinery throughput schedules or additions to crude stocks, which early in September were at the approximate desired level of 249.8 million barrels.

High runs to stills have held crude inventories in check, but resultant additions to storage of the four principal refined products since mid-June have averaged 400,000 barrels a day, or 25 percent more than the daily buildup in the corresponding period of 1950, boosting total supply on September 15 to 287.6 million barrels and widening the margin of product inventories over a year ago.

• • •

GASOLINE PRODUCTION during August and part of September increased slightly to an average of 3.1 million barrels a day, compared with 2.8 million barrels a year previous, checking some of the late seasonal decline in motor fuel stocks. These now appear to be leveling off in a 113- to 114-million-barrel range, compared to the desired end of the heavy consuming season position of about 110 million barrels.

The spread in gasoline stocks over a year ago was 10 million barrels on September 15, compared with 8½ million barrels a month earlier and 12½ million barrels in mid-July. Uneven distribution of inventories with a large volume of the total concentrated in the Indiana-Illinois-Kentucky area and along the East Coast has been reflected during the summer in retail market prices. Price "wars" have been especially widespread in New Jersey and some New England areas.

• • •

DISTILLATE STOCKS continue to mount sharply, though the rate of increase has tapered slightly in recent weeks. Inventories climbed to a new peak of 92.5 million barrels in mid-September, 18.4 million barrels higher than a year previous. The level in August was 18 million barrels greater than a year earlier in August, but in mid-July the position was 12.2 million barrels ahead of the like 1950 period. Despite this indicated improvement in the trend of distillate inventory increase, the early fall supply was nearly 6 million barrels higher than the late November peak of 1950, and further sizeable additions to storage can be expected during the next two months. Following a successful summer fillup campaign in the East, some price easing was noted on the East and Gulf Coasts as early as late August.

Export demand for U. S. produced residual and a decline in imports of this fuel accounted for a check in rapidly mounting stocks with a down turn in mid-September. Bulk of Iran's refinery production consisted of 250,000 barrels daily of residual and it is anticipated the residual market will tighten considerably this winter. Some spot shortages in large consuming areas is possible.

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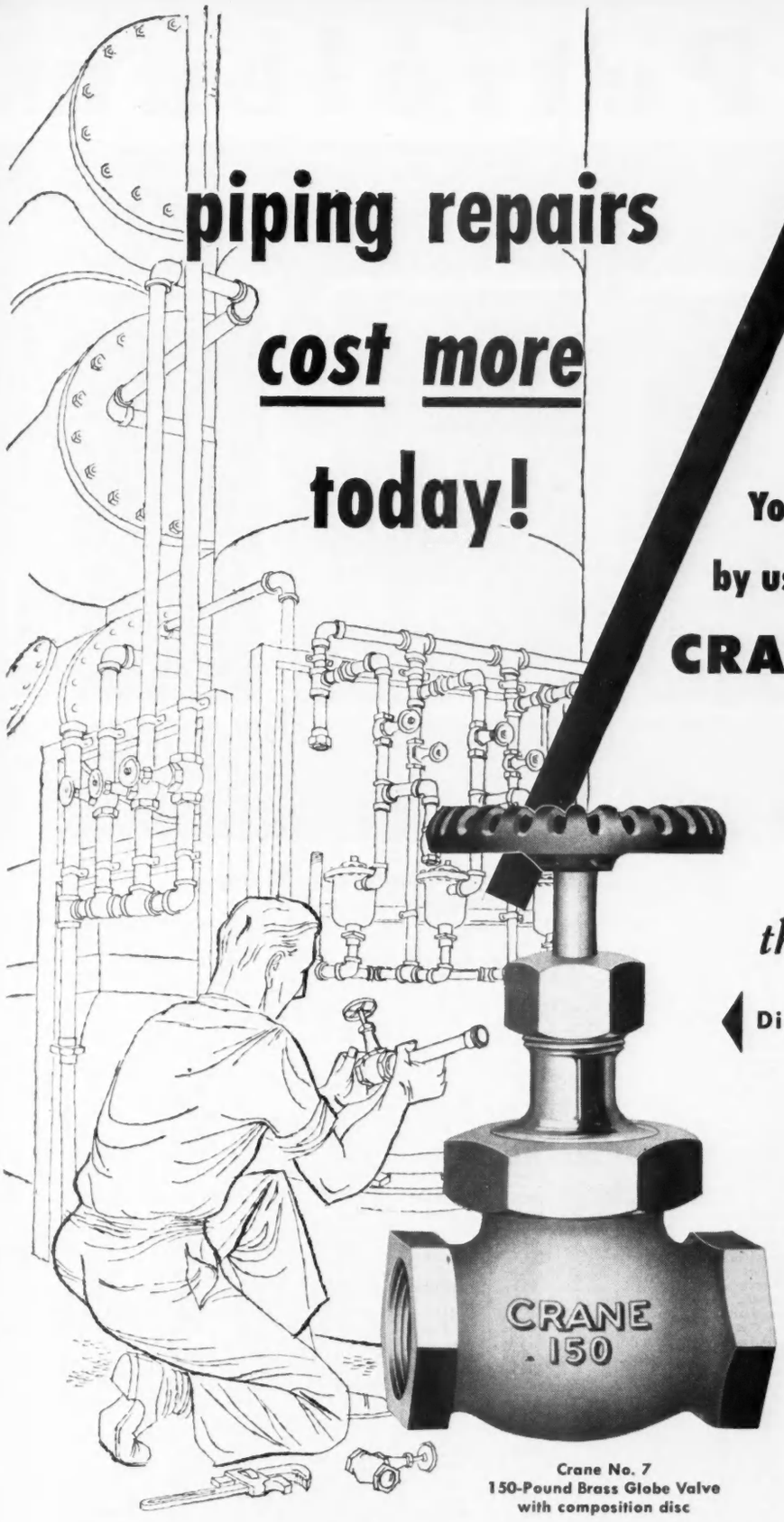


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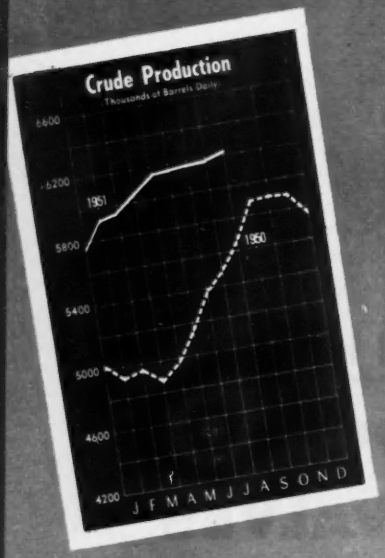
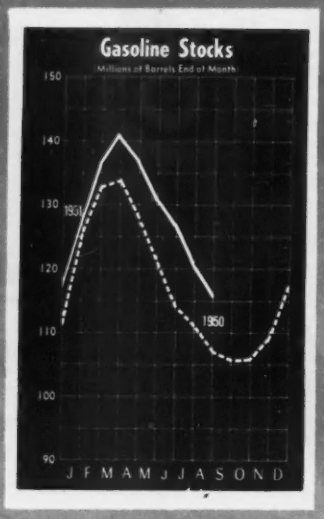
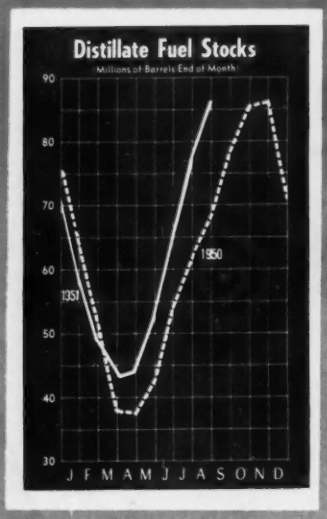
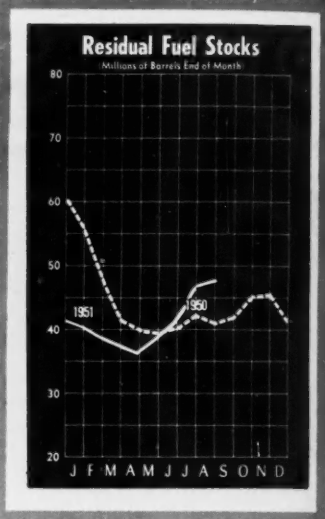
# Petroleum T

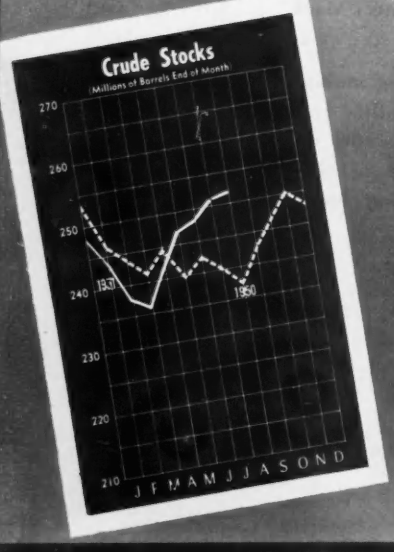
By CECIL W. SMITH,





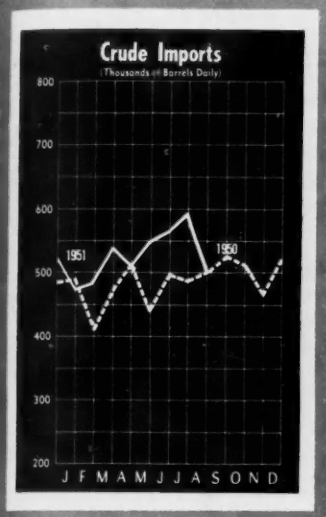

## U. S. Crude Production by States

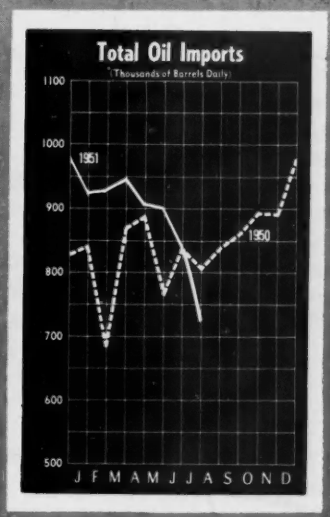
(THOUSANDS OF BARRELS)

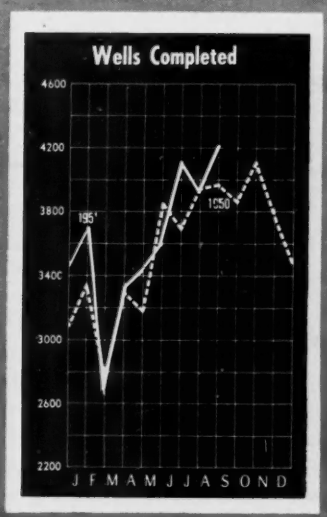
| STATE or DISTRICT | DAILY AVERAGE PRODUCTION | | | | TOTAL PRODUCTION First Eight Months | | |
|---|---|---|---|---|---|---|---|
| | August, 1951 | July, 1951 | August 1950 | % Diff. August, '51-'50 | 1951 | 1950 | % Diff. '51-'50 |
| Alabama | 3.0 | 3.1 | 2.4 | + 25.0 | 701 | 433 | + 61.9 |
| Arkansas | 81.5 | 81.1 | 86.4 | — 5.7 | 19,811 | 20,843 | — 5.0 |
| California | 978.6 | 977.7 | 899.3 | + 8.8 | 235,209 | 212,076 | + 10.9 |
| Colorado | 77.2 | 72.6 | 60.4 | + 27.8 | 18,070 | 14,676 | + 23.1 |
| Florida | 1.6 | 1.7 | 1.6 | ..... | 392 | 295 | + 32.9 |
| Illinois | 170.6 | 170.4 | 174.1 | — 2.0 | 39,836 | 41,409 | — 3.8 |
| Indiana | 32.0 | 30.3 | 28.4 | + 12.7 | 6,751 | 6,578 | + 2.6 |
| Kansas | 321.0 | 309.1 | 292.0 | + 9.9 | 75,827 | 70,544 | + 7.5 |
| Kentucky | 30.9 | 29.4 | 29.8 | + 3.7 | 7,123 | 6,562 | + 8.5 |
| Louisiana | 641.2 | 642.2 | 585.0 | + 9.6 | 154,262 | 135,426 | + 13.9 |
| North Louisiana | 127.0 | 127.0 | 121.4 | + 4.6 | 29,637 | 29,657 | — 0.1 |
| South Louisiana | 514.2 | 515.2 | 463.6 | + 10.9 | 124,625 | 105,769 | + 17.8 |
| Michigan | 37.9 | 38.8 | 43.8 | — 13.5 | 9,483 | 10,776 | — 12.0 |
| Mississippi | 104.1 | 103.6 | 109.9 | — 5.3 | 24,966 | 25,131 | — 0.7 |
| Missouri | 0.1 | 0.1 | 0.1 | ..... | 19 | 19 | ..... |
| Montana | 26.1 | 25.0 | 22.5 | + 16.0 | 5,991 | 5,330 | + 12.4 |
| Nebraska | 6.3 | 6.4 | 3.4 | + 85.3 | 1,754 | 685 | +156.1 |
| New Mexico | 145.7 | 145.7 | 134.6 | + 8.2 | 34,626 | 31,524 | + 9.8 |
| New York | 14.1 | 13.9 | 11.7 | + 20.5 | 2,968 | 2,775 | + 7.0 |
| North Dakota | ..... | ..... | ..... | ..... | 3 | ..... | ..... |
| Ohio | 8.9 | 8.7 | 10.0 | — 11.0 | 2,121 | 2,281 | — 7.0 |
| Oklahoma | 506.5 | 506.3 | 478.5 | + 5.9 | 123,108 | 104,753 | + 17.5 |
| Pennsylvania | 28.5 | 28.4 | 34.5 | — 17.4 | 7,513 | 7,816 | — 3.9 |
| Tennessee | 0.1 | 0.1 | 0.1 | ..... | 9 | 15 | — 40.0 |
| Texas | 2,811.1 | 2,784.3 | 2,473.7 | + 13.6 | 661,288 | 516,908 | + 27.9 |
| Dist. 1—South Central | 33.7 | 33.2 | 29.5 | + 14.2 | 8,049 | 6,670 | + 20.7 |
| Dist. 2—Middle Gulf | 164.5 | 164.0 | 143.3 | + 14.8 | 39,387 | 30,684 | + 28.4 |
| Dist. 3—Upper Gulf | 495.7 | 492.0 | 450.7 | + 10.0 | 119,392 | 95,290 | + 25.3 |
| Dist. 4—Lower Gulf-S.W. | 261.4 | 257.3 | 225.8 | + 15.8 | 61,652 | 48,497 | + 27.1 |
| Dist. 5—East Central | 55.9 | 54.9 | 41.2 | + 35.7 | 12,489 | 7,996 | + 56.2 |
| Dist. 6—Northeast | 390.2 | 390.4 | 377.7 | + 3.3 | 94,255 | 83,845 | + 12.4 |
| Dist. 7-B—North Central | 82.0 | 82.0 | 72.6 | + 12.9 | 19,908 | 16,164 | + 23.2 |
| Dist. 7-C—West Central | 110.5 | 107.1 | 68.3 | + 61.8 | 24,016 | 13,834 | + 73.6 |
| Dist. 8—West | 971.3 | 958.2 | 847.7 | + 14.6 | 223,679 | 160,429 | + 39.4 |
| Dist. 9—North | 159.9 | 158.0 | 154.2 | + 3.7 | 37,451 | 34,164 | + 9.6 |
| Dist. 10—Panhandle | 86.0 | 87.4 | 92.0 | — 6.5 | 21,542 | 22,130 | — 2.7 |
| Utah | 3.7 | 3.6 | 3.3 | + 12.1 | 893 | 776 | + 15.1 |
| Virginia | 0.1 | 0.1 | 0.1 | ..... | 12 | 15 | — 20.0 |
| West Virginia | 7.7 | 7.7 | 8.0 | — 3.8 | 1,833 | 1,902 | — 3.6 |
| Wyoming | 188.8 | 189.7 | 170.7 | + 10.6 | 45,792 | 38,764 | + 18.1 |
| Total United States | 6,227.3 | 6,180.0 | 5,664.3 | + 9.9 | 1,480,361 | 1,258,312 | + 17.6 |

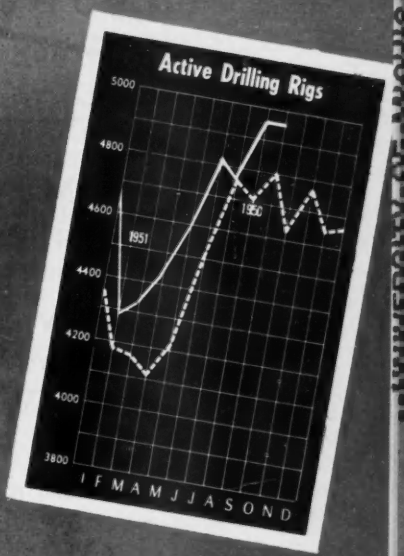
# Trends in U. S.

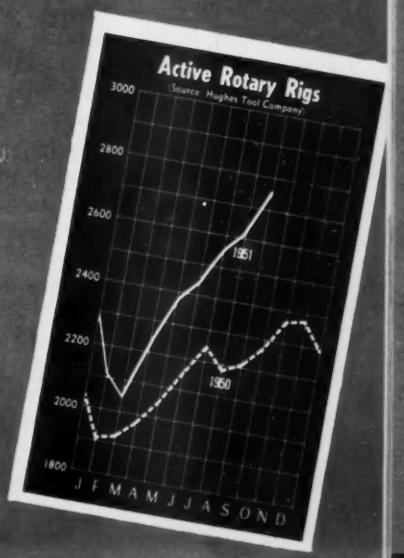
WORLD OIL Staff





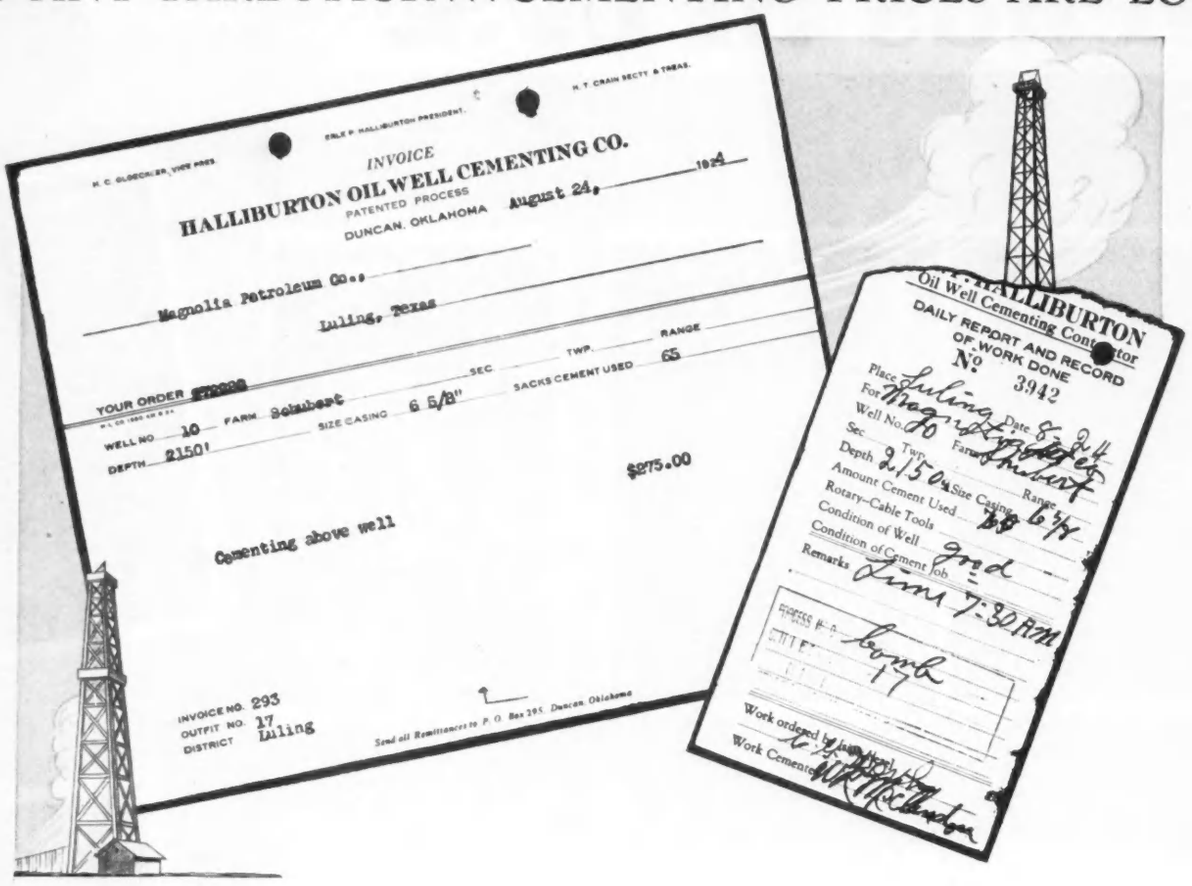




## Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

| MONTH | CRUDE OIL | | | GASOLINE | | DISTILLATE FUEL | | RESIDUAL FUEL | | DAILY IMPORTS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production Daily | Runs to Stills Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Crude Oil | Total Oils |
| **1949:** | | | | | | | | | | | |
| August | 4,780 | 5,241 | 260,585 | 2,593 | 104,879 | 902 | 76,037 | 1,078 | 66,843 | 413 | 614 |
| September | 4,940 | 5,427 | 251,689 | 2,617 | 101,799 | 1,002 | 83,213 | 1,110 | 67,117 | 374 | 623 |
| October | 4,997 | 5,373 | 250,932 | 2,643 | 103,287 | 1,001 | 90,643 | 1,141 | 68,673 | 492 | 785 |
| November | 5,210 | 5,293 | 256,010 | 2,594 | 104,707 | 962 | 88,212 | 1,180 | 65,112 | 435 | 703 |
| December | 5,024 | 5,475 | 253,356 | 2,633 | 111,521 | 1,032 | 75,207 | 1,203 | 60,193 | 485 | 828 |
| **1950:** | | | | | | | | | | | |
| January | 4,922 | 5,483 | 246,610 | 2,575 | 125,298 | 1,048 | 63,932 | 1,209 | 55,808 | 487 | 841 |
| February | 4,967 | 5,316 | 243,750 | 2,552 | 132,796 | 1,026 | 52,206 | 1,172 | 47,828 | 411 | 684 |
| March | 4,878 | 5,336 | 241,098 | 2,539 | 133,766 | 938 | 37,777 | 1,154 | 41,860 | 471 | 869 |
| April | 4,968 | 5,193 | 244,605 | 2,508 | 128,057 | 977 | 37,530 | 1,048 | 39,979 | 511 | 888 |
| May | 5,143 | 5,535 | 239,877 | 2,647 | 121,035 | 997 | 42,739 | 1,063 | 39,482 | 439 | 766 |
| June | 5,378 | 5,655 | 242,287 | 2,748 | 114,074 | 1,037 | 53,679 | 1,069 | 40,124 | 498 | 838 |
| July | 5,484 | 5,882 | 240,270 | 2,835 | 111,055 | 1,040 | 62,555 | 1,140 | 42,165 | 486 | 806 |
| August | 5,665 | 6,067 | 237,393 | 2,932 | 107,067 | 1,089 | 68,426 | 1,148 | 40,979 | 501 | 839 |
| September | 5,888 | 6,059 | 242,311 | 2,849 | 105,748 | 1,180 | 78,270 | 1,178 | 41,966 | 525 | 859 |
| October | 5,900 | 6,077 | 246,424 | 2,875 | 105,764 | 1,217 | 85,643 | 1,250 | 45,004 | 510 | 896 |
| November | 5,891 | 6,085 | 250,016 | 2,859 | 109,005 | 1,218 | 86,113 | 1,240 | 45,048 | 466 | 891 |
| December | 5,758 | 6,092 | 247,814 | 2,872 | 117,220 | 1,307 | 70,875 | 1,280 | 41,184 | 521 | 979 |
| **1951:** | | | | | | | | | | | |
| January | 5,907 | 6,450 | 243,107 | 2,962 | 128,479 | 1,427 | 58,424 | 1,368 | 40,317 | 499 | 977 |
| February | 5,930 | 6,562 | 235,247 | 2,906 | 137,243 | 1,419 | 47,587 | 1,382 | 39,409 | 468 | 937 |
| March | 6,052 | 6,469 | 233,824 | 2,908 | 141,456 | 1,327 | 42,978 | 1,348 | 37,516 | 483 | 861 |
| April | 6,127 | 6,183 | 243,180 | 2,821 | 139,188 | 1,171 | 44,736 | 1,230 | 36,910 | 511 | 871 |
| May | 6,170 | 6,436 | 248,418 | 3,031 | 132,261 | 1,210 | 55,273 | 1,265 | 39,317 | 518 | 876 |
| June | 6,130 | 6,575 | 248,170 | 3,100 | 129,812 | 1,254 | 67,839 | 1,277 | 41,566 | 563 | 876 |
| July | 6,180 | 6,491 | 251,400 | 3,094 | 120,496 | 1,239 | 77,864 | 1,291 | 45,061 | 596 | 815 |
| August | 6,227 | 6,545 | 252,144 | 3,112 | 115,306 | 1,273 | 87,034 | 1,243 | 47,476 | 498 | 725 |
| **Aug., 1951 Change:** | | | | | | | | | | | |
| In Month | +47 | +54 | +744 | +18 | —5,190 | +36 | +9,170 | —48 | +2,415 | —98 | —90 |
| In Year | +562 | +478 | +14,751 | +180 | +8,239 | +184 | +18,608 | +95 | +6,497 | —3 | —114 |
| **Week Ended:** | | | | | | | | | | | |
| 9–15–51 | 6,282 | 6,544 | 250,490 | 3,103 | 114,318 | 1,262 | 92,528 | 1,228 | 47,972 | 411 | 601 |
| 9–16–50 | 5,938 | 5,983 | 237,155 | 2,804 | 104,305 | 1,188 | 74,136 | 1,166 | 42,208 | .... | .... |

# BY ANY YARDSTICK... CEMENTING PRICES ARE LOW




Many things have happened since the invoice and job ticket reproduced above were written.

The man who signed the job ticket as cementer—W. R. McClendon—is now president of Halliburton Oil Well Cementing Company.

Wells have gone deeper and the price of everything we eat, wear or use has gone up according to the government's Consumers Price Index, which now stands at 185 plus.

But there is one item that is actually LESS today than the figure shown in this long-ago invoice of August 24, 1924—the cost of the average cementing job.

By any yardstick, Halliburton cementing prices are low.

Erle P. Halliburton

Chairman of the Company

HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

# Monthly News Analysis

## Industry's Chances Slim Of Getting Enough Steel

Chances are slim that adequate steel supplies will be available to the petroleum industry for meeting expansion goals during the remainder of this year and early 1952, despite the gradual rise in the nation's steel-making capacity and indicated higher allocation requests of Petroleum Administration for Defense.

Actual deliveries of the essential metal continue to run behind authorizations. Further, allocations are well below original planned allocations under the industry's attempts to meet PAD's proposed 1 million barrels daily of additional refining capacity and 250,000 barrels daily additions to annual crude oil productive ability. The government materials distribution agency to the petroleum industry has indicated its requests for all types of steel for 1952 will exceed 10,700,000 tons, approximately one-third more than the scheduled deliveries during the current year; but such an allocation would depend directly on completion of the steel industry's expansion program, which would boost ingot-making capacity to an annual rate of 110 million tons by the end of 1951, up 5 million over the rate a year previous.

Steel's expansion, however, is suffering from inadequate supplies of structural material, with the allocation of National Production Authority to the industry for the final three months of this year reduced to 89,468 tons, or 51 percent of the tonnage requested. In face of the limited supplies granted the steel industry, Defense Mobilizer Charles E. Wilson has called on the industry to step up by six months its three-year expansion plan to reach a rate of 118 million tons of ingot capacity annually scheduled for the end of 1952.

Both Petroleum Administrator Bruce K. Brown and Rear Admiral B. B. Briggs, chairman of the Munitions Board's Joint Petroleum Committee, have warned that the petroleum industry is falling increasingly behind its programmed expansion plans, due to a lag in materials deliveries and the resultant inability to complete additions to productive capacity in step with increases in demand.

The total tonnage of tubular goods for domestic operations so far this year has been insufficient and is estimated to be 5 to 10 percent below the amount required to drill at the annual rate of 43,400 wells, according to a survey of Russel B. Brown, general counsel of the Independent Petroleum Association of America. The survey found that producers' 1950 historical basis for allocation has proved inequitable in cases where this year was not representative of actual needs and completely unrelated to future requirements. Continuing on such a basis, it was predicted, may create real hardships with regard to development of new pools, offset drilling and satisfaction of lease obligations.

IPAA suggested that PAD consider changing its basis for allocation to include an alternate base period and that consideration be given to drilling records of individual producers during the three years, 1948, 1949 and 1950, where the use of 1950 as a base year proves inequitable. It was further suggested that field stocks be increased an additional 5 percent above the present 5 percent of tubular goods already allocated for wildcat activities to handle normal requirements of producers drilling 11 or less wells per year in the base period.

## Nickel Cutback Effects To Be Felt by Industry

The industry will feel this month the effects of a cutback in nickel allocations to steel mills that supply rock bit manufacturers. Beginning in September, the National Production Authority directed these mills to furnish rock bit makers with a modified grade 4600 series steel containing 1.75 percent nickel in place of the customarily used 4800 series steel with a nickel content of 3.5 percent.

NPA, however, has authorized an increase in the molybdenum content of the steel used for making rock bit cutters as a hardening agent in place of the lower nickel content in a move to partially offset the effects of the cutback in nickel. Petroleum Administration for Defense officials stated the change in the steel specifications probably will mean the life of the average rock bit will be reduced by from 3 percent to 5 percent. Noting that such a reduction in quality would increase the number of round trips required to change bits during drilling and thereby impede the over-all oil and gas production program, PAD said the total use of steel in manufacturing bits will be increased in proportion to any reduction in life of rock bits.

Rock bit manufacturers have advised PAD that as soon as 4600 series steel is received they plan to begin extensive tests in an effort to develop cutters that will give as nearly as possible the same life as cutters now used.

PAD estimated production of rock bits requires 35,000 tons of steel and more than 1000 tons of nickel annually. The heavy loads on bits necessitate manufacture of the cutters from high-alloy heat treated steel. Domestic and foreign drilling operations, according to PAD estimates, use about 720,000 rock bits annually.

## Flaring of Gas Troubles Texas Rail Commission

Members of the Texas Railroad Commission have expressed concern over the sharp increase in gas flaring during this year's expansion of output to the highest levels in history.

Operators explain that the increased flaring of gas has been caused by inability to get equipment delivered and installed fast enough to handle extra gas.

In January of this year Texas produced 78,163,185 barrels of crude and flared 2,320,000 Mcf of gas. In July the oil production totaled 84,889,438 barrels, an increase of 8.6 percent, and gas flaring amounted to 5,500,000 Mcf, an increase of 137 percent. Prior to this year, Texas gas flaring had declined from nearly 6 million Mcf monthly to about 2 million Mcf. This reduction of waste was possible because the industry spent millions of dollars on gasoline plants to process the casinghead gas, and much of the residue gas went into pipe lines.

The Railroad Commission has pointed out that the greatest increase in gas waste has occurred in West Texas fields. Cited as examples of places where serious waste was occurring were the Kelly-Snyder field of Scurry County, the Goldsmith gasoline plant in Ector County, the Waddell plant in Crane County, and the Keystone plant in Winkler County. Plans to reduce this waste were de-

scribed to the commission by operators during the mid-September statewide proration hearing at Austin.

The commission has issued a statement declaring that steps should be taken to alleviate gas waste either by reducing oil production days (and daily average production allowables) or else by reducing gas-oil ratios of individual wells. The commission seeks to restrict gas production to the amount which gasoline plants and gas transmission lines can handle. It was having noteworthy success in doing this until the latter part of 1950. But at that time the Korean war imposed sharply increased demand on Texas production, and allowables have been stepped up sharply, with the result that in some cases production of crude allowables has involved waste of the casinghead gas accompanying the oil.

The Railroad Commission is expected to ask for further discussion of the gas waste problem at the next monthly statewide proration hearing, to be held at Beaumont October 9. That hearing will be at 3 p.m., following the convention of the Texas Mid-Continent Oil and Gas Association. It was scheduled for that time so that federal officials at the convention could see how the Texas commission operates.

## Industry Tells Its Story To Public This Month

The American public doubtless still has many misconceptions about the petroleum industry, and in its own interest the industry must continue to tell of its operations, achievements, and problems, so that the people will understand the industry and be sympathetic with it.

Oil Progress Week, an annual fall event, is scheduled this year for October 14-20. This event is observed throughout the country and is the climax of each year's work by the industry in its public relations program. This program is carried out under leadership of the Oil Industry Information Committee of the American Petroleum Institute. The public relations work has been going on for five years, having been initiated in 1946.

The program makes use of virtually every medium for distributing information, including magazine advertising, radio, motion pictures, pamphlets, posters, and meetings. Basic materials are furnished to schools. Industry speakers appear before hundreds of organizations each year, telling the story of oil. Much of the information is aimed specifically at the 2 million employes of the oil industry, who are expected to relay it to relatives, friends, and gatherings.

The program revolves around three major points, because surveys have shown that the public has had erroneous ideas regarding these three important matters. Information is offered to show that: (1) The industry is competitive and definitely not monopolistic; (2) the industry is progressive and operates in the public interest; and (3) prices are determined by the economic laws of supply and demand.

Results of each year's public relations work are reviewed when the API holds its annual meeting in November. At that time, plans for the coming year are made and members are chosen to work on the committees that lead the industry in telling the oil story.

## Additional Cuts in Quotas Of Tetraethyl Lead Feared

Further cutbacks in tetraethyl lead quotas to refiners can be expected unless ways are found to increase supplies of metallic lead to TEL manufacturers, according to C. E. Davis, director of the Petroleum Administration for Defense's refining division.

National Production Authority's September allocation of only 40 percent of the primary metallic lead required to keep makers of TEL operating at capacity may result in a reduction of supplies of the anti-knock ingredient as much as 47 percent below the distribution effective in August under PAD Order No. 1, Davis predicted. A reduction of that amount would have the effect of an across-the-board cut of three octane numbers in gasoline quality on an average basis.

PAD's order restricted refiners to a base allotment of 1 million pounds of TEL plus 80 percent of their 1950 consumption in excess of 1 million pounds during the 12-month period which started March 1. Prior to NPA's cutback in lead supplies in September, the original PAD order had resulted in a slight reduction in motor fuel octane ratings.

PAD has appealed to NPA for relief in the September cutback on the grounds that tetraethyl lead is of vital importance in maintaining the civilian economy, and that the relatively small amount of metallic lead required to satisfy these requirements could well be diverted from present government stockpiles or from other uses less important to the civilian population.

## More Fuel Oil Production Needed to Avert Shortages

Increased production of residual fuel oil will be necessary to avoid severe shortage during the coming winter. The threat of a shortage has been raised by a combination of factors, including especially the Navy requirements for Navy Special Fuel Oil and the shutdown of the Abadan, Iran, refinery, heretofore a large producer of this product.

The Petroleum Administration for Defense is actively considering possible means of encouraging refiners to increase their output of residual.

However, solving the problem apparently must involve primarily a stepping up of crude runs to stills and sacrificing gasoline yields in favor of higher residual yields. And such changing of refinery yields would involve financial loss to refiners, especially under the price control program that exists. With both gasoline and residual prices frozen and the latter bringing in only comparatively low revenue, the production of residual naturally is discouraged rather than encouraged.

In seeking to prevent serious shortage of residual, PAD is expected to consider also the possibilities of holding down demand for residual through substitution of coal for oil at some power plants and other industrial plants along the East Coast.

In late September it was indicated that PAD might resort to the use of directives to Gulf Coast and East Coast refiners to obtain additional production of Navy special fuel oil. PAD suggested to the Armed Services Petroleum Purchasing Agency that such directives might be employed, provided that agency, with concurrence of the Office of Price Stabilization, would agree to compensate refiners for their extra out-of-pocket costs involved.

PAD also proposed that if qualified suppliers desire, it would put into effect a share-the-burden program under which other refiners would be required to divert some part of their residual fuel oil to them to offset residual losses to the Navy Special program. PAD refining division officials in late September were due to meet with refining company representatives and determine the views of the latter on these proposed plans.

# *Thinking of Oil Financing?*

Owners and producers of oil and natural gas are invited to consult with our Oil Department on their financial problems.

All inquiries on petroleum and related matters will receive prompt attention.

## Empire Trust Company

**NEW YORK**

Downtown Office:
120 BROADWAY
Equitable Building

Uptown Office:
7 W. 51st STREET
at Rockefeller Center

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

## No Final Senate Action On Tidelands Is Expected

It was indicated in late September that there would be no final Senate action on tidelands legislation before the coming adjournment of Congress. Still snagged in the Senate Interior Committee, headed by Senator O'Mahoney (D. Wyo.) was the tidelands quitclaim bill approved by the House, along with alternate proposals, including the administration bill for federal administration of the submerged lands.

Most significant development in the tidelands situation lately is the move of the administration toward seizure of tidelands within the harbor of the city of Long Beach, Calif. Irving M. Smith, Long Beach city attorney, charged the Interior Department with "threatened, arrogant, bureaucratic" intention to "seize possession" of tidelands within the harbor unless the city agrees to pay the federal government part of its oil royalties. He further warned that the threatened action would become a pattern for similar moves regarding tidelands and submerged lands within the state boundaries of Texas, Louisiana, Florida, and other states.

Smith explained that the payments are sought to compensate the federal government for drainage of lands lying seaward of harbor facilities. But the city claims the areas involved, and city officials assert that, furthermore, in-harbor wells caused no drainage problems.

A representative of the Interior Department was said to have warned city officials that failure of the city to agree to payments would result in Interior and Justice departments taking "all appropriate and necessary steps in the matter." The city officials gained the impression that the Department of Interior intended to seize the lands involved and issue oil leases on them even without prior congressional authorization, if Congress should fail to take early action on the tidelands question.

## Increased Exports Reflect Abadan Refinery Shutdown

A sharp increase in exports of refined products from the U. S. in July reflected the stepping up of shipments to Europe in substitution for products previously supplied by the Abadan refinery in Iran. Shutdown of that large refinery, following nationalization of the Iranian oil industry, evidently was largely responsible for the jump of nearly 100,000 barrels a day in U. S. petroleum exports in July, as compared with June.

Total exports of crude and products rose to an average of 470,200 barrels daily in July from 372,300 barrels daily in June, Census Bureau statistics indicated. Crude exports were down slightly, but exports of refined products were up sharply. Shipments of aviation gasoline rose to approximately 35,000 barrels daily in July from 24,000 daily in June. Motor fuel exports of 72,000 barrels per day contrasted with 38,000 daily in June. Distillate fuel oil was shipped abroad at the rate of 74,000 barrels daily in July, compared with 38,000 daily in June. Residual fuel exports jumped to 103,000 barrels per day in July from 82,000 daily in June. Lubricating oils for most purposes, including aviation and automotive, were shipped out in greater quantities, as were natural gasoline, liquefied petroleum gas, and petroleum asphalt.

Among the repercussions of the increase in exports precipitated by the Iranian refinery shutdown has been a tightening of the supplies of heating oils for U. S. domestic markets, particularly in New England.

## Plans for U. S. Synthetic Plant Hit by R. E. Wilson

The proposal that the U. S. government spend $400 million to build a plant to produce synthetic fuels from coal, sponsored by Secretary of Interior Oscar Chapman, is a threat of government encroachment in the oil business. A warning against this threat was sounded by Dr. Robert E. Wilson, chairman of the board of Standard Oil Company of Indiana in a recent address before the Tulsa Rotary Club. He likened the project to the Tennessee Valley Authority projects, which put the government strongly in private business in the electric power field.

The Chapman proposal has been made seriously and at a time when steel is short, said Wilson. "For roughly half the steel and half the money," he declared, "an equal quantity of gasoline and other fuels could be obtained from petroleum. We are not a long way from socialism if present trends continue."

To curb "revolution by nibbling" and save freedom of the U. S. economy, Wilson offered a six-point program for men of industry and business. He said they should make sure their own house is in order; stop running to Washington to invite government intervention in business problems; actively "sell" the American way; unite with other industries and professions in defending freedom; help all who benefit from oil understand the economics of the oil industry; and help show people that in trying to expand social "benefits," bureaucrats really are trying to buy people's votes with the people's own money.

Wilson later spoke before the Oil Forum of the Tulsa Chamber of Commerce and invited all to join him in a "crusade to save freedom" of not only oil companies but also all business and all individuals. Without freedom from bureaucratic control, he declared, the oil industry's service to the people "would surely wither." In the industry there must be freedom, he said, to explore at will, conduct research, seek capital, build plants and facilities, earn profits with which to finance expansion and maintain credit, and even the freedom to go broke.

## Gasoline Remains Choice Product of Refineries

Gasoline remains the choice product of the petroleum refiner, despite emphasis in recent years on diesel oil, heating oil, and some special products. The importance of gasoline lies in its top position in both volume of sales and price.

That refiners still are primarily makers of gasoline was emphasized by recent announcement of plans for construction of a new 25,000-barrel-per-day refinery by Sunray Oil Corporation near Corpus Christi, Texas. The plant is being designed for maximum production of gasoline and will be capable of a yield of 56 percent gasoline from the crude processed.

For the U. S. refining industry as a whole, gasoline yield has ranged this year from 40.4 percent in February to 43.1 percent in June, having been slightly lower than in 1949 and 1950. Peak gasoline yield of recent years was 45.9 percent in June, 1949.

While the current national average gasoline yield is about 43 percent, the yield varies by refining districts, being about 32.5 percent in the North Louisiana-Arkansas area; 37 percent in the California and East Coast districts; 42 to 44 percent on the Gulf Coast; about 45 percent in the Rocky Mountain and Appalachian districts; around 49 percent in Oklahoma-Kansas-North Texas; and 51 percent in Illinois-Indiana.

All fuel oils, including kerosine, are made in combined volume about the same as gasoline. Current yields of these products from crude are about 5 percent for kerosine, 19 percent for distillate fuel oil, and 19.5 percent for residual fuel oil. Lubricating oil yield for the nation is about 2.6 percent.

# What about these new improvements in Lane-Wells Packers?

## Are they part of Engineered Packer Service?

NEW "SLYDEZE" SLIPS

BOCI PACKER

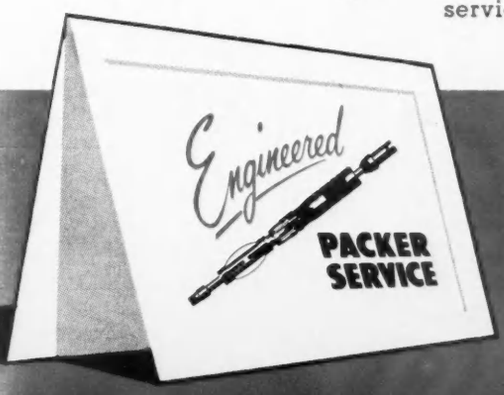
*Tomorrow's Tools -Today!*

They certainly are—even though not listed in Engineered Packer Service 7-Point program. It hardly seemed necessary to say that Lane-Wells is, naturally, always working to improve its equipment and services. But "Packer Development" *could* be listed as the *8th* point, as these two examples show:

After many months of experiment and tests, a way was found to give the backs of Lane-Wells slips a permanent, practically friction-free surface. Field tests show that these SLYDEZE SLIPS release freely even under severe service conditions.

For formation fracturing, secondary recovery or pressure acidizing —any job which concentrates tremendous pressure below the packer— these new BOCI Packers do a wonderful job. They set by *tension* . . . hence, the greater the pressure below, the tighter these packers set. They release easily, too.

***Ask your Lane-Wells Man*** for more information on these, or on the already-famous 7 points—1. Packer Application. 2. Packer Selection. 3. Packer Set-ups. 4. Packer Setting. 5. Packer Pulling. 6. Packer Evaluation. 7. Packer Maintenance—which make up the free advisory service widely known as




by LANE WELLS

General Offices, Export Office and Plant • 5610 So. Soto St. Los Angeles 58, California

Los Angeles • Houston • Oklahoma City
Lane-Wells Canadian Co. in Canada
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# Completions 3.4 Percent Ahead of 1950 Period

THE rate of completions in the U. S. continued to grow during August, resulting in the greatest number of wells and amount of footage ever recorded in a single month. June had previously been the most active drilling month of all time.

During August, 4284 wells were officially completed to top the 4125 credited to June. A total of 16,487,914 feet was represented in August's wells, and that too was a new high level of monthly activity. June's previous record had been 15,463,055 feet.

As a result of August's and the preceding periods' high drilling activity, operations for the first eight months of 1951 held sizable leads over the record-drilling year of 1950. At the end of August, the year's total wells amounted to 29,407, which was a gain of 3.4 percent over the 28,439 completed during the first eight months of last year.

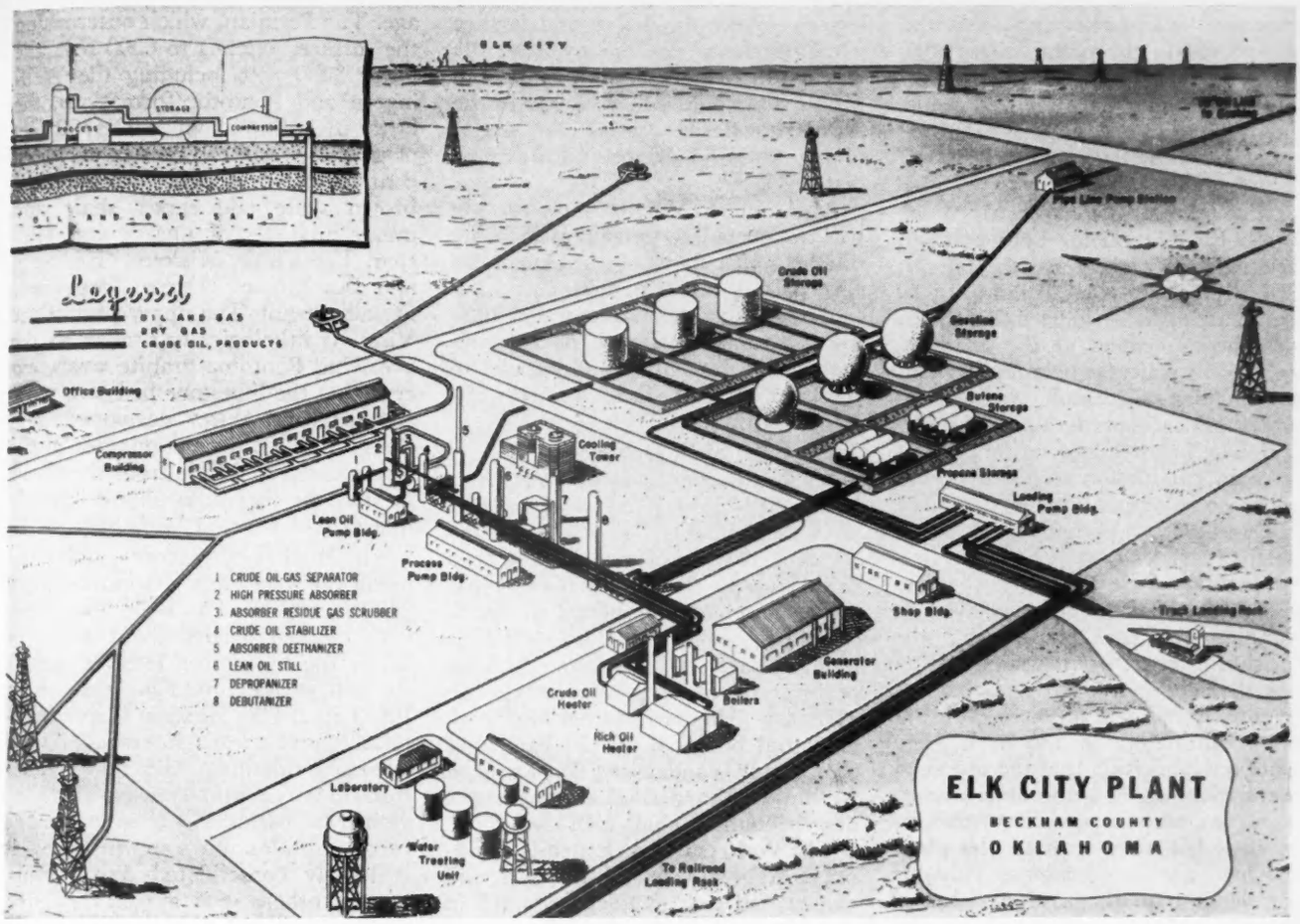
Showing a greater gain, and providing a better measure of activity, was the amount of footage drilled so far this year. By the end of eight months, a total of 111,796,727 feet had been penetrated, and that was not only a new record for eight months, but it topped last year's record by 8.4 percent. As the number of wells had risen only 3.4 percent against the 8.4 percent hike in footage, that could only be the result of deeper drilling.

Each new well drilled this year was 3856 feet deep on the average, while a year ago the average had been 3670 feet. That increase in average depth per well was not so much the result of deeper than usual drilling in particular areas, but rather increased activity in areas where all drilling had been comparatively deep.

## Well Completions in the United States During August, and First Eight Months, 1951

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the *Producers Monthly*.)

| State or District | MONTHLY COMPLETIONS, AUGUST, 1951 | | | | | | | | | TOTAL COMPLETIONS | | | | CUMULATIVE TOTALS January-August | | | | | Rigs in Operation (Drilling, Rigging-Up and Shut Down) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEW WELLS | | | | | | | | Total Drilled Deeper | | | | | | | | | | | | |
| | Oil | Dist. | Gas | Dry | Water Input | Gas Input | Water Disposal | Total New | | Aug., 1951 | July, 1951 | Aug., 1950 | Footage August, 1951 | Wells 1951 | Wells 1950 | Percent Diff. | Footage 1951 | Footage 1950 | Aug. 31, 1951 | July 31, 1951 | Aug. 31, 1950 |
| Alabama | | | | 3 | | | | 3 | | 3 | 4 | 6 | 15,624 | 38 | 30 | + 26.7 | 176,123 | 116,819 | 5 | 4 | 8 |
| Arizona | | | | | | | | | | | | 1 | | 2 | 4 | — 50.0 | 3,820 | 15,597 | 2 | 2 | 4 |
| Arkansas | 27 | | 2 | 17 | | | | 46 | 1 | 47 | 44 | 38 | 147,104 | 272 | 264 | + 3.0 | 931,586 | 884,138 | 35 | 35 | 29 |
| California | 126 | | 2 | 46 | 1 | | | 175 | 12 | 187 | 191 | 160 | 761,698 | 1,588 | 1,248 | + 27.2 | 6,126,763 | 5,030,693 | 236 | 253 | 209 |
| Colorado | 14 | | 1 | 9 | | | | 24 | 1 | 25 | 20 | 12 | 120,841 | 154 | 42 | + 266.7 | 743,687 | 163,109 | 40 | 30 | 15 |
| Florida | | | | 1 | | | | 1 | | 1 | 1 | 1 | 12,600 | 3 | 10 | — 70.0 | 14,614 | 65,685 | | 1 | 2 |
| Georgia | | | | | | | | | | | | | | | 3 | — 100.0 | | 13,270 | | | |
| Idaho | | | | | | | | | | | | | | 1 | 3 | — 66.7 | 12,844 | 8,540 | 1 | | 3 |
| Illinois | 100 | | | 150 | | | | 250 | | 250 | 280 | 299 | 646,433 | 1,523 | 1,813 | — 16.0 | 3,831,218 | 3,874,842 | 201 | 214 | 263 |
| Indiana | 41 | | 2 | 88 | | | | 131 | | 131 | 149 | 174 | 253,408 | 768 | 1,054 | — 27.1 | 1,404,036 | 1,825,962 | 187 | 176 | 204 |
| Kansas | 197 | | 35 | 153 | | | 5 | 390 | | 390 | 396 | 300 | 1,355,156 | 2,717 | 2,511 | + 8.2 | 9,266,999 | 8,104,792 | 422 | 439 | 348 |
| Kentucky | 53 | | 19 | 47 | | | | 119 | 1 | 120 | 122 | 142 | 243,607 | 824 | 772 | + 6.7 | 1,663,659 | 1,404,221 | 99 | 104 | 112 |
| Louisiana | 129 | 8 | 27 | 91 | | | | 255 | 1 | 256 | 178 | 233 | 1,408,318 | 1,439 | 1,620 | — 11.2 | 9,132,275 | 9,746,641 | 229 | 227 | 242 |
| North Louisiana | 81 | 5 | 23 | 62 | | | | 171 | 1 | 172 | 96 | 148 | 625,148 | 794 | 864 | — 8.1 | 3,048,193 | 3,009,497 | 77 | 73 | 70 |
| South Louisiana | 48 | 3 | 4 | 29 | | | | 84 | | 84 | 82 | 85 | 783,170 | 645 | 756 | — 14.7 | 6,084,082 | 6,737,144 | 152 | 154 | 172 |
| Maryland | | | 1 | 3 | | | | 4 | | 4 | 4 | | 17,034 | 23 | 1 | + 2200.0 | 91,124 | 3,612 | 28 | 26 | 2 |
| Michigan | 18 | | 5 | 45 | | | | 68 | 1 | 69 | 59 | 73 | 150,827 | 470 | 535 | — 12.2 | 1,174,500 | 1,267,049 | 111 | 102 | 147 |
| Mississippi | 9 | | 3 | 26 | | | | 38 | | 38 | 50 | 25 | 236,851 | 241 | 235 | + 2.6 | 1,551,285 | 1,690,686 | 37 | 37 | 25 |
| Missouri | | | | | | | | | | | | | | 3 | 23 | — 87.0 | 658 | 14,585 | 6 | 6 | 7 |
| Montana | 16 | | | 21 | | | | 37 | | 37 | 34 | 56 | 94,418 | 179 | 173 | + 3.5 | 411,710 | 442,200 | 46 | 57 | 39 |
| Nebraska | 3 | | | 12 | | | | 15 | | 15 | 11 | 10 | 77,332 | 97 | 58 | + 67.2 | 451,570 | 243,154 | 18 | 12 | 12 |
| Nevada | | | | | | | | | | | | | | 2 | | | 15,431 | | 1 | 2 | 2 |
| New Mexico | 31 | | 17 | 7 | | | | 55 | 2 | 57 | 59 | 61 | 326,017 | 450 | 411 | + 9.5 | 2,158,005 | 1,813,034 | 149 | 117 | 95 |
| New York | 31 | | | | 22 | | | 53 | | 53 | 51 | 91 | 76,155 | 359 | 512 | — 29.9 | 511,523 | 761,204 | 60 | 63 | 114 |
| North Dakota | | | | 2 | | | | 2 | | 2 | 3 | | 5,036 | 6 | | | 33,799 | | 6 | 7 | 4 |
| Ohio | 21 | | 21 | 36 | | | | 78 | 4 | 82 | 97 | 86 | 175,957 | 596 | 636 | — 6.3 | 1,190,013 | 1,319,722 | 149 | 167 | 157 |
| Oklahoma | 292 | 1 | 22 | 188 | 28 | 1 | 4 | 536 | 12 | 548 | 421 | 430 | 1,973,003 | 3,707 | 3,466 | + 7.0 | 13,304,299 | 12,157,435 | 610 | 616 | 644 |
| Oregon | | | | | | | | | | | | | | | | | | | | | 1 |
| Pennsylvania | 64 | | 11 | 3 | 66 | 4 | | 148 | 2 | 150 | 142 | 156 | 243,369 | 996 | 1,074 | — 7.3 | 1,717,753 | 1,947,423 | 252 | 262 | 263 |
| South Dakota | | | | | | | | | | | | 2 | | | 3 | — 100.0 | | 12,380 | 1 | 1 | 1 |
| Tennessee | | | | | | | | | | | 4 | | | 6 | 3 | + 100.0 | 7,465 | 3,993 | 9 | 9 | 8 |
| Texas | 1,004 | 11 | 95 | 556 | 4 | 2 | | 1,672 | 26 | 1,698 | 1,512 | 1,549 | 7,645,382 | 12,035 | 11,108 | + 8.3 | 52,206,111 | 47,184,733 | 1,701 | 1,651 | 1,487 |
| Dist. 1 S. Central | 33 | | | 41 | | | | 74 | 7 | 81 | 37 | 54 | 205,037 | 423 | 324 | + 30.6 | 1,201,677 | 904,583 | 29 | 34 | 39 |
| Dist. 2 Middle Gulf | 32 | 4 | 4 | 33 | | | | 73 | | 73 | 54 | 73 | 464,961 | 509 | 451 | + 12.9 | 2,972,878 | 2,598,434 | 66 | 62 | 54 |
| Dist. 3 Upper Gulf | 73 | 5 | 10 | 40 | | | | 128 | | 128 | 146 | 142 | 812,538 | 1,040 | 1,052 | — 1.2 | 6,423,450 | 6,154,176 | 136 | 125 | 130 |
| Dist. 4 L. Gulf-S.W. | 74 | | 13 | 61 | | | | 148 | 2 | 150 | 169 | 160 | 770,259 | 1,165 | 1,111 | + 4.9 | 5,730,376 | 5,329,731 | 126 | 125 | 131 |
| Dist. 5 E. Central | 26 | | | 16 | | | | 42 | | 42 | 43 | 22 | 188,456 | 321 | 136 | + 136.0 | 1,235,231 | 581,196 | 26 | 34 | 16 |
| Dist. 6 Northeast | 27 | 2 | 4 | 19 | | | | 52 | 1 | 53 | 64 | 64 | 263,564 | 489 | 425 | + 15.1 | 2,457,901 | 2,055,858 | 40 | 42 | 32 |
| Dist. 7-B N. Central | 130 | | 5 | 142 | | | | 277 | 1 | 278 | 245 | 174 | 862,507 | 1,863 | 1,302 | + 43.1 | 5,348,287 | 3,662,849 | 194 | 196 | 116 |
| Dist. 7-C W. Central | 116 | | 2 | 47 | | | | 165 | | 165 | 110 | 112 | 873,910 | 964 | 610 | + 58.0 | 4,374,172 | 2,461,231 | 177 | 173 | 96 |
| Dist. 8 West | 329 | | 3 | 49 | 1 | | | 382 | 13 | 395 | 337 | 407 | 2,201,430 | 2,720 | 2,829 | — 3.9 | 14,748,938 | 15,183,915 | 507 | 470 | 563 |
| Dist. 9 North | 109 | | | 83 | 3 | 2 | | 197 | 2 | 199 | 256 | 229 | 588,410 | 1,956 | 2,195 | — 10.9 | 5,866,175 | 6,131,994 | 274 | 267 | 211 |
| Dist. 10 Panhandle | 55 | | 54 | 25 | | | | 134 | | 134 | 51 | 112 | 414,310 | 585 | 673 | — 13.1 | 1,847,026 | 2,120,766 | 126 | 123 | 99 |
| Utah | 3 | | | 3 | | | | 6 | 1 | 7 | 3 | 4 | 29,575 | 22 | 14 | + 57.1 | 101,352 | 39,685 | 27 | 24 | 8 |
| Virginia | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 |
| Washington | | | | | | | | | | | | | | | 2 | — 100.0 | | 16,032 | 1 | 1 | |
| West Virginia | 2 | | 32 | 9 | | | | 43 | | 43 | 57 | 64 | 128,369 | 394 | 428 | — 8.0 | 1,144,575 | 1,079,996 | 205 | 220 | 265 |
| Wyoming | 38 | | | 32 | | | | 70 | 1 | 71 | 77 | 60 | 343,800 | 492 | 383 | + 28.5 | 2,417,930 | 1,870,853 | 113 | 123 | 83 |
| Total U. S. | 2,219 | 20 | 295 | 1,548 | 121 | 7 | 9 | 4,219 | 65 | 4,284 | 3,969 | 4,033 | 16,487,914 | 29,407 | 28,439 | + 3.4 | 111,796,727 | 103,122,085 | 4,988 | 4,989 | 4,804 |




# Elk City Operators Unite For Conservation

By ANTHONY GIBBON, WORLD OIL Staff

COMPLETION of the gas processing and cycling plant in the new Elk City pool of western Oklahoma is another step in the industry's program to conserve oil and gas resources. The new plant, the first large project of its type in Oklahoma was built by Shell Oil Company, discoverer of the Elk City field in 1947. It is operated by Shell and is owned jointly by the nine major producers in the field.

W. A. Alexander, area manager for Shell at Tulsa, who presided at formal dedication ceremonies recently, calls the project an outstanding example of how natural resources can be conserved through the cooperative efforts of royalty owners and oil operators. Other owners of the plant include E. Constantin, Jr., Continental Oil Company, J. M. Huber Corporation, The Superior Oil Company, Tide Water Associated Oil Company, Union Producing Company, United Carbon Company, Inc., and Wilcox Oil Company.

Located in the center of the Elk City oil and gas field, the plant is expected to increase the recovery of liquid hydrocarbon products from the field by about 25 million barrels. In addition, it will conserve billions of cubic feet of gas for sale as fuel besides furnishing gas for cycling back into the producing formation.

The new plant, which cost approximately $7 million and is capable of processing 100 million cubic feet of gas daily, has a number of distinctive features. It was primarily designed to process both crude and condensate as well as natural gas. The effluents are produced from the wells directly into

**THIS ARTICLE describes the new Elk City gas processing and cycling plant, first of its kind in Oklahoma. It is estimated that the system, maintaining the reservoir pressure and recovering liquid products from gas processed, will increase the recovery of liquid hydrocarbons from the field by about 25 million barrels and will conserve and put to use billions of cubic feet of gas. Built at a cost of $7 million, the plant's processing capacity is 100 million cubic feet of gas per day.**

a common field gathering system and transported to the plant, where they are processed into propane, depropanized gasoline, and stabilized crude, with the residue gas being returned to the formation through 13 gas injection wells.

Although nine companies are active in the Elk City field, 4240 acres in the field, involving as of June 1, 1951, 106 forty-acre drilling tracts, are operated as a single unit. To secure the agreement of the oil operators and royalty owners for the unitization plan, a formula was worked out to allocate production from the field. The formula allots a 50 percent share in production to acreage and the other 50 percent to the volume of oil-bearing strata underlying each tract.

Operators deserve considerable credit for the foresight displayed in planning the new plant, since the decision to construct it was made before the field had been developed sufficiently to indicate the size plant that would ultimately be required. They could not be certain that the proposed installation would bring about a sufficient increase in product to pay for its cost, but they realized the plant was necessary to conserve valuable petroleum liquids, and displayed enough faith in the field to assume the risk.

That faith has been fully justified, as Elk City has proved to be one of the major oil field discoveries of the past decade.

The Elk City field is in eastern Beckham and western Washita counties, Oklahoma, about five miles south of the town of Elk City. Its discovery was the result of intensive geological and geophysical reconnaissance work primarily directed to prove the theory that important commercial production could be developed in the Anadarko Basin, one of the major and, as yet, undeveloped oil provinces of the U. S.

According to Wilgus[1] the structure was discovered by reflection shooting on the south flank of the Anadarko Basin. It is an elongated, anticlinal fold, about eight miles long and having a structural closure of approximately 400 feet. It trends parallel to the flank of the basin in a northwest-southeast direction.

### Shell Discovery

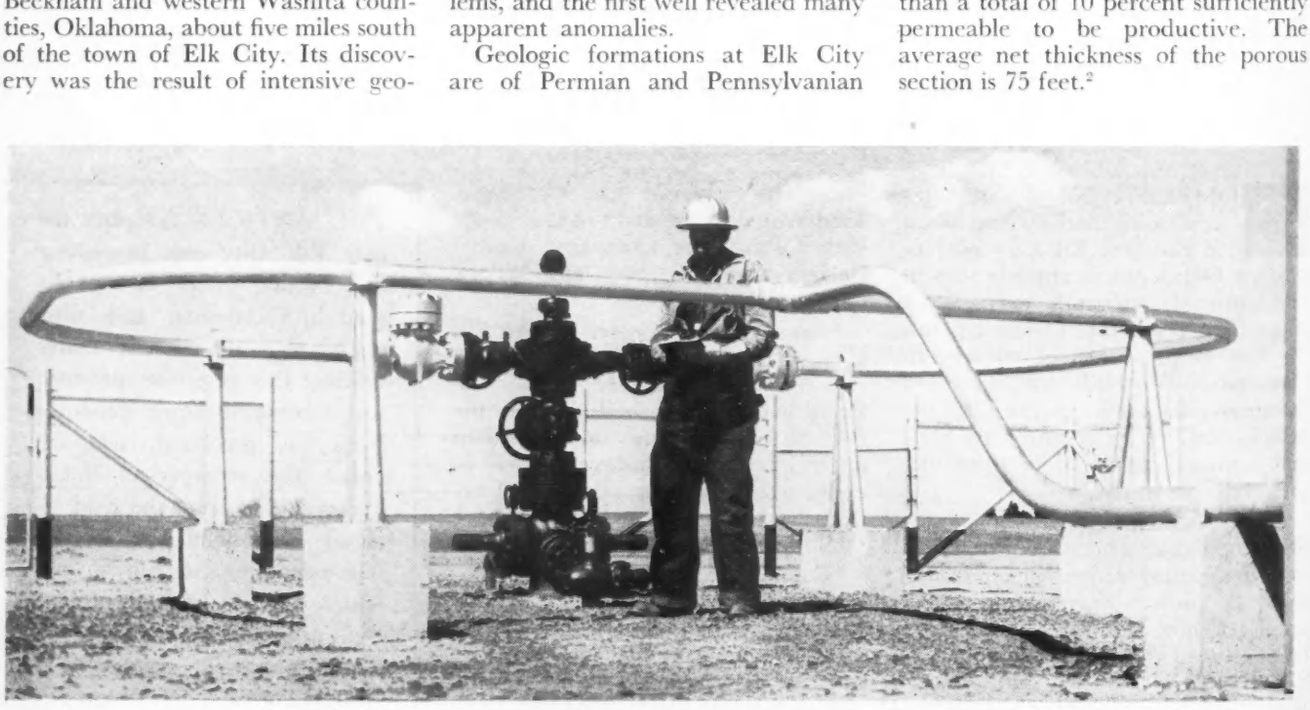
Shell's discovery was the Walters 1, NE-¼ SW-¼ 14-10n-21w, completed in November, 1947. It was drilled to 13,133 feet, one of the deepest tests drilled up to that time in the Anadarko Basin and bottomed in Pennsylvanian sediments. The well was plugged back and completed through perforations at 9260-9360 feet in the Missouri (Hoxbar) formation, with an initial potential of 470 barrels of 65.4 gravity condensate, 25 barrels of fresh water, and 5541 Mcf gas per day through one-half-inch choke.

The Walters was an expensive wildcat, costing in excess of $750,000, and emphasized that exploration work in the deep beds of the Anadarko Basin was an undertaking for major oil companies or well financed independents.

Geologists and production men engaged on the discovery were confronted with many subsurface problems, and the first well revealed many apparent anomalies.

Geologic formations at Elk City are of Permian and Pennsylvanian age. The Permian, which outcrops on the surface, extends to 6500 feet, the lower 3000 feet including the Wellington and Pontotoc formations, the latter including about 1500-1700 feet of granite wash, the matrix of which contains a very high percentage of brown shale and sandy shale and minor amounts of quartz and feldspar. The Virgil, Missouri (Hoxbar), and Des Moines (Deese) formations are all present. The upper part of the Virgil is lithologically similar to the overlying Pontotoc granite wash, except that the limestone beds are more frequent and better developed, and the granite wash predominates in the lower part but differs from the above in that the matrix is almost entirely quartz and feldspar with little shale.

The Hoxbar lies unconformably beneath the Virgil and is approximately 2400 feet thick. The Belle City limestone, which occurs about 800 feet below the top of the Hoxbar, marks the top of the producing column at Elk City. The Hoxbar is predominantly granite wash, interbedded with lenses of limestone and sandy limestone in varying thicknesses. This conglomerate varies widely in its degree of cementation. In some instances it is loosely consolidated and porous, and in others it is a well-cemented dense mass, with little or no permeability. This is the reservoir rock that comprises about 75 to 80 percent of the Hoxbar. Commercial oil, gas and condensate are found over a 1500-foot interval between 8800 and 10,300 feet, but there is seldom more than a total of 10 percent sufficiently permeable to be productive. The average net thickness of the porous section is 75 feet.[2]



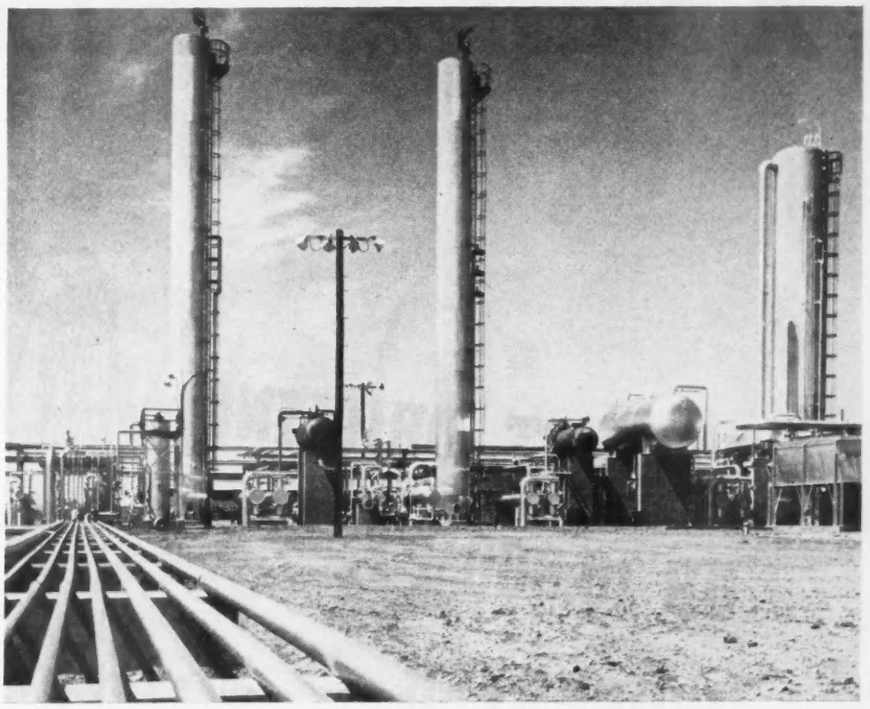
**Gas injection wells in the Elk City field return dry gas to the reservoir to maintain pressure. The expansion bend in the pipe is designed to accommodate high pressure injection gas.**

Characteristics of the producing horizon have made drilling hazardous. This is because commercial production depends on the degree of permeability encountered in each individual well. Permeability varies throughout the entire field, as does the type of production. Gas and gas condensate predominate, with liquid gravities of 60 to 65 degrees API. High gravity crudes range from 43 to 55 degrees. Reservoir gas contains between 90 and 175 barrels per million of butanes and heavier hydrocarbons. Gas condensate wells yield from 60 to 200 barrels of liquid hydrocarbons per million cubic feet of gas.

Reserves at Elk City were estimated previously at 47 million barrels, based on primary recovery from 6700 proven acres. Actually, the ultimate recovery is now expected to approach 100 million barrels of crude and volatiles, based on the conservation factor and because about 9000 acres appear proven, with the limits of the field still undefined. Original average bottom-hole pressure was about 4100 pounds per square inch, and formation temperatures range from 165 to 180° F. There are approximately 145 wells completed, on 40-acre spacing, and gas is being injected into the reservoir by 4300 psi pressure.

At present 50 wells in the 106-tract unit flow into the plant through a 900 pounds per square inch gauge field gathering system, providing about 12,000 barrels of stabilized crude and 120 million cubic feet of gas daily in the plant. About 65 additional wells, yielding approximately 8000 barrels of crude and 30 million cubic feet of gas daily produce through stage separation to stock tanks throughout the field. Approximately 80 million cubic feet of gas per day is being injected into the formation to maintain the reservoir pressure.

Production from the wells passes through a field gathering system operated at 900 psig into two crude oil separators, where oil and condensate are separated from gas. The crude leaving the separators is passed to a crude oil flash tank operating at 285 psig. The flashed gas, after recompression and cooling passes together with the high pressure crude oil separator gas into an absorber operating at 900 psig. The rich oil leaving the bottom of the absorber enters a rich oil flash tank, after which the evolved vapors enter the suction of the 285 psig recompressor, along with the crude oil flash tank gas. The flashed rich oil is pressured to the rich oil de-ethanizer.



**View of Elk City gas processing and cycling plant operated by Shell Oil Company on behalf of itself and eight other oil companies comprising the Elk City Unit in western Oklahoma. The plant extracts propane, butane and natural gas from wet gas and cycles dry gas back into the formation to maintain pressure in the reservoir.**

The raw crude leaving the 285 psig crude oil flash tank is fed to a crude oil fractionator after exchanging heat through a series of heat exchangers with both hot bottoms and overhead vapors, and after final heating through a direct-fired heater. The overhead is partially condensed through the respective feed heat-exchanger into an accumulator; from this accumulator the condensed liquid passes through a cooler together with the stabilized crude oil into the crude oil storage tanks. The non-condensed vapors emerging from the overhead accumulator are fed to the rich oil de-ethanizer.

The condensation of the overhead occurs at an optimum temperature, selected so that the condensate may contain a minimum quantity of propane and lighter products and a maximum quantity of material of an end point higher than 225° F. This is in order to retain the heavy components in the crude oil and also restrict the final vapor pressure of the crude oil to the 13-pound Reid range.

Injection of absorber residue gas into the producing formation is accomplished through seven-1350 horsepower, two-stage compressor units boosting the gas from 900 to 4300 psig.

The rich oil de-ethanizer residue gas furnishes fuel to the plant boilers, oil heaters and engines. Absorber residue is used as make-up fuel whenever required.

There are periods when the demand for propane is so low that it becomes necessary to dispose of it by other means. Connections are provided to presaturate the absorber lean oil with propane to reduce the amount absorbed, allowing the propane to remain in the residue gas to be returned to the reservoir for future recovery.

Present daily plant capacity is 75,000 gallons of propane, 200,000 gallons of depropanized gasoline, and 20,000 barrels of stabilized crude oil and condensate. However, application has been made to the Petroleum Administration for Defense for permission to construct new facilities to handle an additional 50 million cubic feet of gas per day. This proposed expansion also includes new compressor facilities to inject 60 million more cubic feet of gas daily into the Elk City field. This will make a total of 140 million cubic feet of gas returned daily to the producing formation.

The industry's total investment at Elk City to date, including drilling expenses, a 160-mile pipe line to Cushing, Oklahoma, and the new plant, now total more than $40 million.

**REFERENCES**

[1] Wilgus, Dr. W. L., "The Elk City Pool," WORLD OIL, June, 1950.
[2] Ibid.

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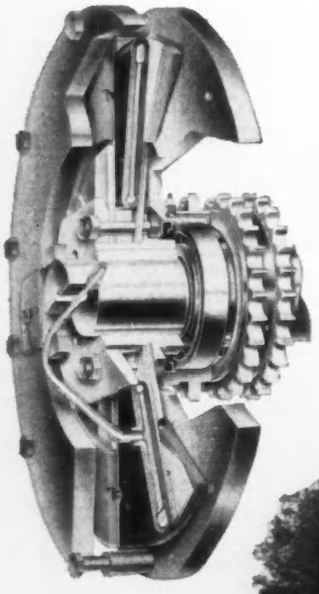

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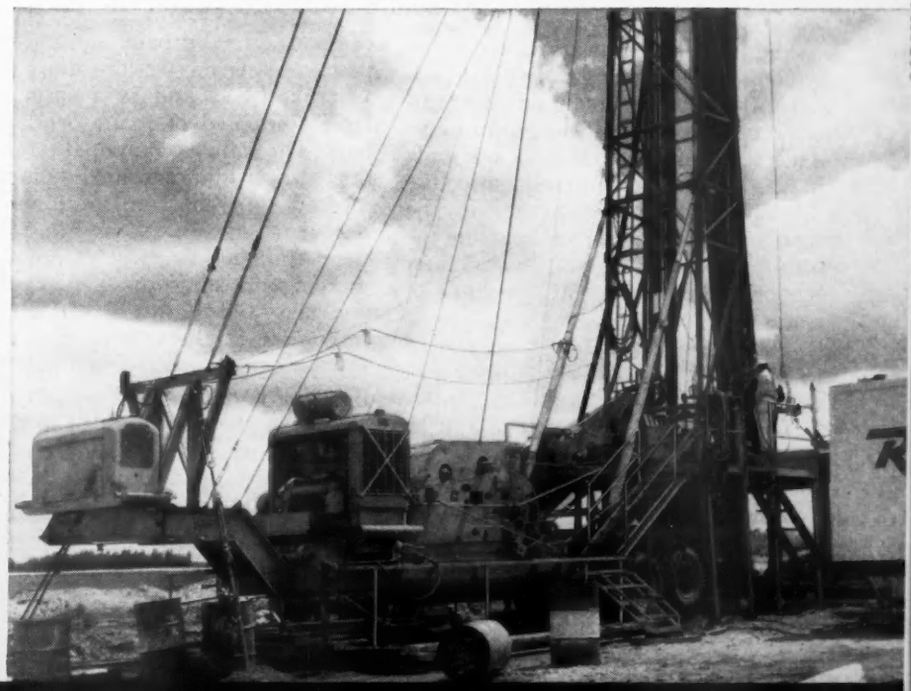

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TWENTY-FIVE YEARS CARDWELL SERVING THE OIL INDUSTRY

# World's Largest Water-Flood Project

# To Save

# 140 Million Barrels of Oil

By ANTHONY GIBBON

WORLD OIL Staff

New style pumping equipment being installed to produce water flood production.

THE world's largest water-flood project, embracing more than 22,000 acres in the North Burbank pool of Osage County, Oklahoma, is now under way. The first 1000 acres are being repressured as the initial step in a long-range plan. An additional 140 million barrels of oil, which otherwise would have been lost, is expected to be recovered over a period of some 18 years.

The project demonstrates the value of cooperation among individual producers, and is an example of teamwork on the part of varied interests. This teamwork is reflected not only in the pooling of interests affecting the oil producing properties in the North Burbank pool, but also in the formation of the Ark-Burbank Water System to supply the large volume of water required.

The Burbank pool was discovered in May, 1920, with the completion of the discovery well in SE NE 36-27n-5e. It was extended very rapidly, and by the end of 1926 development of the main part of the pool was considered complete. Under preconservation practices wells were produced under wide open production methods, flowing, swabbing and pumping to capacity. Peak production of 122,000 barrels per day was reached in July, 1923, after which the field, in typical fashion, declined rapidly. Approximately 225 million barrels of oil have been produced by the Burbank pool, part of which is in adjoining Kay County. That part of the pool in Osage County, and now embraced in the North Burbank Unit, has produced about 170 million barrels of oil.

The producing formation is the Burbank sand, of Pennsylvania age, with an average thickness of 43 feet, and for the entire field the unit area comprises about 900,000 acre feet of sand. The Burbank sand was deposited along the western shore of the Cherokee Sea and is a large sand lense composed of many overlapping bars. The sand is composed largely of fine and medium-grained quartz cemented with silica, dolomite and calcite. In addition, there are present small amounts of mica carbonaceous matter consisting of 5 percent silt and clay and 10 to 20 percent rock fragments of chert, shale and schist.

The reservoir energy of the North Burbank pool was supplied practically wholly by the gas dissolved in the oil. In only one area, the northwestern edge of the pool, along a three-mile tract, was there evidence of water encroachment, but due to the limited extent of water sand body west of the pool, the expansive power of the water was rapidly dissipated and up to the present time has advanced only about three-quarters of a mile into the pool proper.

There was no initial gas cap existing in the high part of the structure. However, a few gas caps appear to have existed in localized areas where the sand tops were high.

In an effort to halt decline of oil production some operators inaugurated gas repressure operations on a limited scale as early as 1926, but it was not until 1935, when gas from outside sources was brought into the field for repressuring purposes, that this operation assumed importance. Up to the present time, in addition to returning the available residue gas, more than 17 billion cubic feet of natural gas have been injected into the reservoir resulting in the increased recovery of approximately 17½ million barrels of oil.

Because of the application of dry gas injection and vacuum the gravity

**WATER-FLOODING operations have been started on a large scale in the Burbank field, Osage County, Oklahoma. This is the largest secondary recovery project ever undertaken. The project is expected to add 140 million barrels to the oil recovery from the 22,000 acre field. Teamwork was employed successfully not only in unitizing the oil producing properties but also in formation of the water system that will supply the large volume of water required.**

of the oil which originally was 40 degrees API has declined to 37 to 38.

Natural depletion of the field due to early wasteful production practices has resulted in the recovery from this reservoir of only 25 percent of the oil initially in place, notwithstanding the supplementary limited gas repressuring program.

### Preliminary Steps

Phillips Petroleum Company, which has engaged in a limited water-flood program since 1936, took the lead in unitizing the North Burbank pool and thus accepted the challenge to increase ultimate recovery from a depleted pool capable of producing millions of barrels of additional oil under modern production practices.

Unitization of producing oil properties poses many difficult problems, but the work of creating the North Burbank Unit was unique.

All oil royalty or revenue from minerals extracted from the Osage Tribal lands that constitute Osage County, are property of the Osage Tribe rather than the individual surface owners. The tribe's oil interests are under the supervision of the Secretary of the Interior and the Osage Indian Agency located at Pawhuska. Under tribal policy, that part of the North Burbank pool in Osage County amounted to a common royalty interest and was the primary reason that prompted the North Burbank Operators to limit the unit to those lands in Osage County. Thus, the unit excludes that part of the pool located in Kay County, which is operated as separate leasehold estates and diverse royalty interests.

Early in 1947, at the insistence of the Secretary of the Interior, the North Burbank Operators started negotiations to unitize the various leaseholds into a single lease. A critical consideration was that of obtaining the consent of the Osage Tribe to a reduction of royalty payments from one-sixth, which was the policy adopted by the Tribe at the time the oil leases were granted, to the usual one-eighth so that a competitive position could be achieved by the North Burbank Operators in relation to other leases that were suitable for water-flooding held in counties outside Osage County. The operators further petitioned the Osage Tribe to substitute a blanket oil mining lease to replace the individual leases under which they had previously been operating.

Operating interests were unitized on the basis of accumulated production, current production, and productive acreage, all three factors given equal weight in computing unit interests. The 18 separate operators owning leases that comprised the North Burbank Unit drafted an Operating Agreement among themselves, with interest determined by the above-mentioned factors, and Phillips Petroleum Company was selected as the operator of the Unit. (Phillips is the largest interest holder in the Unit.)

The Unit became effective at 7 a.m. November 14, 1949, with the approval by the Department of the Interior of the blanket oil mining lease covering the Unit area (approximately 22,000 acres) and granting reduction in royalty from one-sixth to one-eighth of the reserve to be recovered by the water-flood process.

By approval of a reduction from one-sixth to one-eighth royalty for water-flood oil, the Osage Tribe made a far-sighted move to make Osage County competitive with surrounding counties for capital investment in water-flood development. The accumulated crude production from Osage County has exceeded 500 million barrels. Engineers have estimated that 400 million barrels additional can be recovered by water-flooding. The additional recovery expected from the North Burbank Unit as a result of the water flood to be undertaken is 140 million barrels. This volume is comparable to the 170 million barrels recovered by natural depletion and gas repressuring from the unit area prior to unitization. Therefore, this development, enabled by the royalty reduction, will not only substantially increase the revenue of the Osage Tribe, but also represents a great conservation move for Oklahoma. On the basis of the expected water-flood reserve, and the present price of crude, the state will collect approximately $16 million in severance tax from the North Burbank Unit.

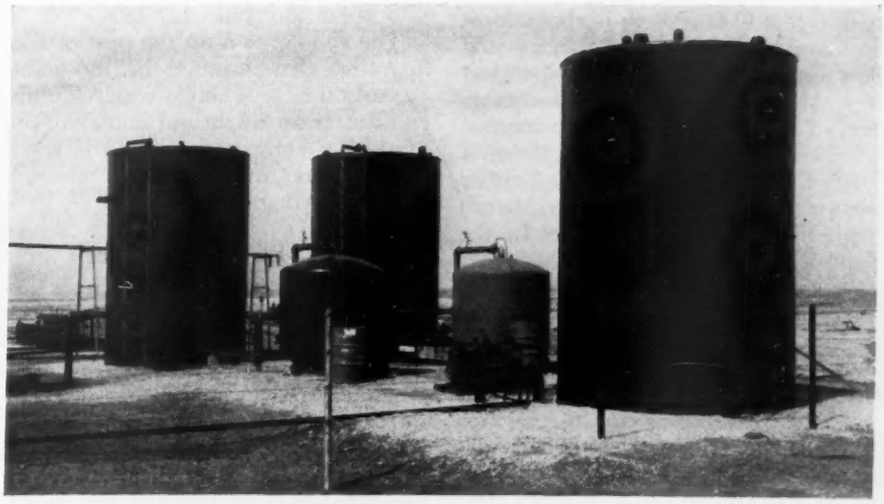
### Pilot Water Flood

In December, 1949, immediately following the issuance of the blanket oil mining lease on November 14, 1949, the North Burbank Operators started the development of pilot water flood.

Because of the size of the undertaking, the Unit lessees commenced a 90-acre "pilot" operation in 16-26n-6e in February, 1950, to get necessary operating information to design effectively and carry on the type of operation required to water flood the entire field. Nine input water wells were drilled on a five-spot pattern to the existing 16 producing wells. First water was injected on February 25, 1950. The first response to water-flooding on the 90-acre pilot tract occurred in September, 1950, after 1,200,000 barrels of water had been injected, when the production from the 90 acres was raised from 37 barrels per day to 404 barrels per day. The peak production on the 90-acre tract was reached in January, 1951, at 987 barrels per day. As of June 1, 1951, more than 170,000 barrels of oil have been recovered as a result of the water-flood operations on the 90-acre tract. The rate of production on that date was 675 barrels per day.

Water for injection on the 90-acre tract was obtained from salt water produced on the Unit and from an industrial water source that represented temporary arrangement. For that reason, there were times when the supply of water was limited or when weather conditions interfered with the injection on the pilot tract.

The water-flood reserve was computed by the difference in oil saturation at the time of unitization and a residual oil saturation of 23 percent of the total void space after water-flooding. The residual oil saturation after water-flooding was determined



**Water filtering equipment to clarify water prior to injection.**

from cores taken on flooded out properties of similar sand characteristics.

The total sand volume was determined from drillers' logs using as control about 14 core tests that had been drilled in the field. Drillers' logs were interpreted for 2210 wells in the field upon which data were available. To determine the position of the top of the sand, top of the oil saturation, and base of the oil sand, 14 cross-sections at intervals of two-thirds of a mile and one longitudinal section were drawn. These data were used to prepare an isopachous map assigning the greatest weight to the cored wells and next to the cross-sections rather than individual well locations in order to minimize errors in determining sand thickness which are usually associated with drillers' logs.

Unfortunately, there was no information as to solubility of gas in oil or the formation volume factor for the North Burbank field; however, these data were available from the South Burbank field and were used in the computation of original oil in place in the North Burbank Unit. Porosity values were taken from the core analysis and weighted as to the location of the core test within the Unit.

From the above data it was computed that there were 140 million barrels of oil to be recovered from the North Burbank Unit by water-flooding. This reserve figure is also in close agreement with the yardstick commonly employed in water-flooding using accumulated production and adjusting for the volume of oil that has been produced by gas repressure.

Water-flood operations on the North Burbank Unit would require a maximum of 200,000 barrels of water per day, and investigation of the sources of water demonstrated that the most economical and reliable source of water was the Arkansas River, about seven miles west of the Unit. The preliminary design of the water system to supply the North Burbank Unit with water dictated that there would be substantial savings to the operators in surrounding pools by the construction of a joint water system adequate for the North Burbank Unit, together with the properties in the Stanley Stringer, Mid-Burbank Unit, South Burbank Unit, and properties in the Fairfax pool.

Twenty-eight oil operators in the above-mentioned pools and units joined in the formation of the Ark-Burbank Water System, for the purpose of supplying water for water flooding in the Burbank Area. The Ark-Burbank Water System is designed to deliver 300,000 barrels of water per day for water flooding. The design was based on the nominations submitted by all of the operators as constituting their peak demand in the course of water-flooding their properties. The installation cost was apportioned among the operators on the basis of their water nominations. The operating expense is to be apportioned on the basis of actual volume of water delivered during the month.

Source of water is from wells drilled to the alluvium along the banks of the Arkansas River. These wells are drilled to the bed rock and about 40 feet of water-bearing sand and gravel is exposed in the well bore. These wells have been tested to a capacity of 40,000 barrels per day. At that rate the water is clear, demonstrating that adequate filtering is obtained by drawing the water through the sand and rock and precludes the installation of surface filters. Mineral content is such that no deposition is expected from the water, and treatment will be limited to the injection of a bactericide to prevent the growth of organic material.

Water from the water wells is pumped to a 40,000-barrel collector tank to provide settling of sand in the event sand is produced with water. From the collector tank the booster station will pump the water through the line system at such pressure as to provide 25 pounds per square inch at the wellhead of any well served by the Ark-Burbank Water System. The Ark-Burbank Water Distribution System constitutes seven miles of 30-inch line running from the Arkansas River to a point in the approximate center of the North Burbank field, and an additional five miles of 24-inch line running south in the North Burbank field, an extension of three miles of 18-inch line to the South Burbank field. From this central trunk water system other lines will be laid by the respective unit operators to expand the system to all points of use. The North Burbank portion of this water-flood system was put into operation June 12, 1951.

The cooperation on the part of the operators demonstrated by the joint construction of a single water system constitutes an important conservation of steel as compared to the construction of three or more water systems from the Arkansas River.

### Water-Flood Development

The North Burbank Operators are going forward with the development of the Unit and are presently developing 1000 acres for water flood.

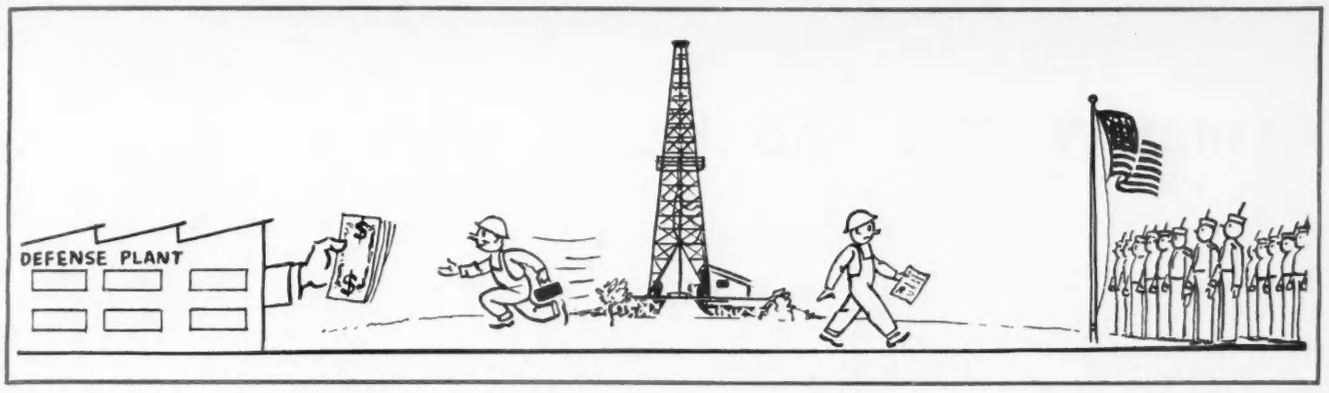
The Burbank field was originally developed on a regular ten-acre spacing. The old wells are available for use in the water flood program except for about 400 wells that have previously been plugged.

The pilot water flood was developed by drilling five-spot water input wells to the existing wells, creating a ten-acre spaced pattern. Performance of the water input wells on the pilot water flood demonstrated that adequate volumes of water could be injected into the wells under hydrostatic head, volumes ranging from 1000 to 2000 barrels per day or from 15 to 30 barrels of water per foot of sand per day.

In view of the injection rates, the operators elected to employ a 20-acre spaced pattern upon expansion of the pilot flood. The 20-acre pattern is accomplished by converting alternate existing wells to water input. The original wells were completed by setting seven-inch casing about 200 feet above the top of the sand and running a 5½-inch liner below that point. It is a rare instance that the liner is set at the top of the sand. Such well completions make it imperative that water input wells be completely reworked to the extent of salvaging the seven-inch casing and liner and running a new casing string to the top of the sand and cementing. The sand top is located by means of radioactive logs.

The existing equipment was designed and installed for a continually declining oil field. It is necessary to replace completely all existing equipment on the lease as water-flooding is expanded. Central powers and jacks are being replaced with pumping units, and new tank batteries of 3000-barrel capacity are being constructed on each quarter section. Tubing, rods, and subsurface pumps are being installed of sufficient capacity to produce 800 barrels of fluid per day. The cost of water-flood development is equal to the cost to initially develop a property such as the North Burbank field.

Present plans call for the water-flood development of 1000 acres per year. A reasonable expectation is that through water-flood operations, according to this plan, the daily production from the field can be raised from a level of approximately 4500 barrels per day to approximately 20,000 barrels per day and maintain at that high rate for at least 13 years in the future. The additional oil recovery expected from the North Burbank Unit as result of water flood to be undertaken is 140 million barrels. This volume is comparable to the 170 million barrels recovered by natural depletion and gas repressuring from the Unit area prior to unitization. Therefore, this development, enabled by the royalty reduction, will not only substantially increase the revenue to the Osage Tribe, but also represents a great conservation move.




# MANPOWER SHORTAGE
## Troubles Drilling Industry

By DON KLIEWER
WORLD OIL Staff

OIL WELL drilling contractors, beset with mounting material costs and scarcity of steel (WORLD OIL, Sept., 1951, pp. 179-180), are furrowing their brows over the tight labor market, and generally agree the labor pool will dry up even more in the immediate future.

Accelerated mobilization, combined with a continuing lack of trained crewmen and the desire of many for employment in businesses with more regular hours, has made terrific inroads into an industry charged with the responsibility of drilling more wells, more wildcats and more footage than ever before.

A recently-completed WORLD OIL survey has uncovered a wide area of pessimism. Because of their proximity to vital defense industries, some areas are being hit harder than others, but throughout the Texas Gulf Coast, East Texas, West Texas, the Texas Panhandle, and Louisiana are reports of heavy turnover of crew members. Offsetting this, a majority of West Coast, Oklahoma, Kansas, and Rocky Mountain contractors reported only normal turnover.

The excess turnover has another disadvantage in the scarcity of qualified men. One contractor whose operations range from the Gulf Coast to Oklahoma reported a 20 percent average turnover of rig personnel on 18 wells during the first five months of this year. The per-well figure ranged from 5 percent to 45 percent. The "5 percent" rig was manned largely by men whose service with the company extended over many months, whereas the majority of crew members on the "46 percent turnover" well had been with the firm a much shorter time.

"The Gulf Coast is tight," another contractor said. "It's getting mighty hard to find drillers and roughnecks. We used to get the cream of young men from rural communities on a seven-day week. Many of them came from farms, but now, with subsidies theirs for the asking, they're staying on the farm. Roughnecks are drifting into steadier jobs, like pipefitting, at which they can make decidedly more money."

### Drillers Stable

The general tendency of drillers to stay with a contractor was noted throughout the survey. The consensus among contractors is that drillers generally will remain with the well either because of their long service with the company or their position in oil field hierarchy.

But the evaporating supply of other rig personnel was explained by a Gulf Coast contractor, whose operations extend to Louisiana, in this way:

"Since the depression, the practice of bidding on well drilling has been in vogue. About six to 15 bids are received on wildcats and field wells, too. This practice depresses price, forcing the contractors to cut corners wherever possible in order to compete. That was possible, from the labor standpoint, when we used to get a supply of good, young men whose speed made up the difference. Now, we can't take up that slack because of the dwindling supply of satisfactory labor."

Another Gulf Coast contractor echoed the plaint that he is losing crewmen to the pipefitting trade at which they can make more than $2.50 an hour, as compared with the $1.35-$1.50 an hour he can pay.

"We are getting by because we are able to keep a skeleton crew of old-time, long-time, skilled men."

Another contractor saw the possibility of some contractors moving from the Gulf Coast "contractor swamped" section to where competition is "less rough."

"We did $1.5 million worth of work from January to June 15, and didn't make a nickel," he said, placing a major portion of the blame on the 40-hour week and its resulting overtime expense.

In East Texas, the same general difficulties face contractors. Heavy turnover, lack of trained personnel, the disinclination of men to "go with the well" if the site is very far from adequate housing for their families, personnel losses to the armed services and to businesses with regular hours combine with a comparative lull in drilling to adversely affect efforts of contractors to keep crews intact.

One East Texas contractor, whose operations extend to Montana, is experiencing a high turnover among

■ CONTINUED ON PAGE 68

# Atomic Warfare And the Oil Industry

By ROBERT C. WING

Cmdr., U. S. Navy

THE atomic bomb has been popularly conceded to be a weapon against which there exists no reliable defense. Members of the general public carry the impression that the nation in possession of the atomic bomb will swiftly and surely prevail over any adversary. It is also generally conceded that if both adversaries should possess the weapon, the inevitable results of its use would be the destruction of each other's industries and centers of population.

In order to test this popular conception against the American petroleum industry it is herein proposed to apply publicly known facts concerning the atomic bomb's destructive potential to equally publicly known facts concerning the American petroleum industry. Necessarily, utilization of data will have to be limited to that which is publicly known and unclassified. It is hoped that the assembly of some general data and a logical application of this data to material published in petroleum industry journals will be considered sufficient for a generally conclusive survey regarding the potentialities of atomic warfare against the American petroleum industry.

The utilization of the atomic bomb against our oil industry, by any foe, is severable into two distinctly different types of application. The first type would be atomic bomb attacks against the petroleum industry facilities within the U. S., and the second would be against our harbors through which much of our petroleum in one form or another must necessarily move as it proceeds from foreign sources to the refineries in our country, or as it proceeds in the form of coastwise trade from American oil fields through the refining centers to the consumers.

Analysis of the potentialities of atomic warfare directly against the petroleum industry necessitates exploring the nature of the target. Where are the production centers; the refining centers; what is the degree of concentration; and what is the trend?

**THE AMERICAN petroleum industry very likely would be under atomic attack in event of war with a power possessing that weapon. Especially would the facilities of the refining division be primary targets, because of their strategic importance and high degree of concentration. This paper is published through courtesy of U. S. Naval Institute "Proceedings."**

Nature ages ago determined the location of crude oil, gas and natural gasoline. "Oil is where you find it," is an industry saying that recognizes the elements of chance in finding oil. Production facilities must be concentrated over the subterranean deposits. During the present decade the great demand for petroleum products has intensified the development of existing fields through additional drilling to already developed production levels, and in many cases, to deeper sands in the same field. The great market demand produces an economic pressure to obtain more and more oil in shorter time from our known fields, and this trend toward forced concentration of production facilities is likely to continue.

Nevertheless, since there are literally hundreds of separate oil and gas fields and tank farms, the concentration in the production end of the petroleum business is not, and cannot, become so acute as in the refining end; nor is it concentrated in a degree that makes it subject to substantial disruption by atomic bombing attack.

In contrast with production facilities, refining facilities in the U. S. are acutely concentrated. In fact, most of our refining capacity is grouped in particular industrial sections of the East Coast in the New Jersey-Pennsylvania area, on the Gulf Coast in a few sections of the Louisiana-Texas industrial area, on the West Coast in a couple of the major industrial areas of California, and again in the Mid-Continent in a couple of the major industrial areas that are accessible to the Mississippi and its tributaries.

Refining of crude petroleum into finished products is a manufacturing process which is peculiarly adaptable to large scale operation. The process requires specialized and expensive equipment which is almost fully automatic in operation. As compared to other major industries, the manpower requirement for operation is small, although the skills required of the operators are very considerable. Virtually the only limitation to refinery size is the quantity of crude available to the plant and the size of the market available within the range of economical distribution.

In the U. S., 18 oil companies own nearly three-quarters of the total refining capacity of the country. The principal refinery construction that took place during World War II was the building of 100 octane gasoline plants. Most of this was financed by industry, and about 80 percent of all the wartime refinery construction was carried out by the 18 companies owning the three-quarters of our refinery facilities. It is therefore easy to understand why the war-time catalytic cracking facilities and other related structures requisite to the manufacturing of high octane aviation gasoline were built within the confines of existing refineries or adjacent to them.

The petroleum industry management is aware of the concentrated nature of the refinery facilities and the undesirable security aspects of this situation. Although an effort is being made to expand the smaller refineries before carrying on with further expansion of the big plants, and in this way slow down some of the abnormalities of concentration, little possibility exists for the development of many new and diverse refinery locations. In a large measure, the industry is powerless to stem the trend. The economic laws are such that expansion through integration with existing facilities gives operating economies, lower cost in steel, manpower, utili-

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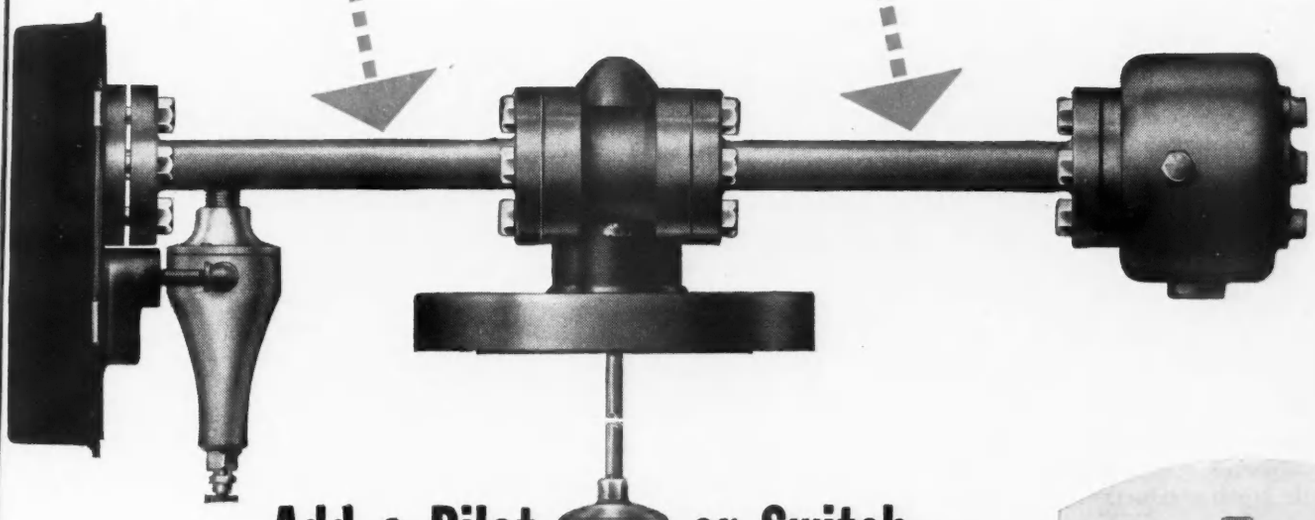

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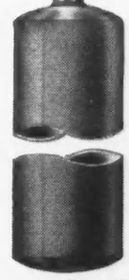

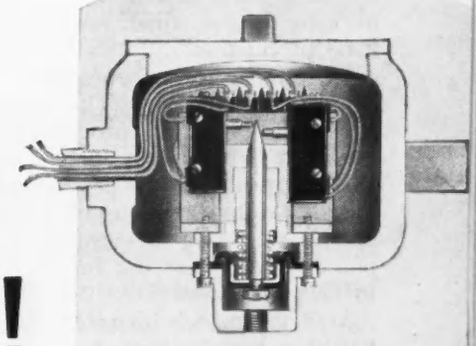

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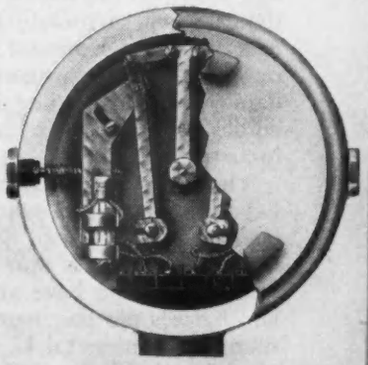

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ties, and housing savings that cannot be achieved through the erection of completely new units. The short supply and high cost situation in steel, housing, skilled manpower, and the struggle for operating profits make the trend for concentration virtually inevitable.

The demand for all petroleum products has increased tremendously, and additions are being made to existing terminals, both marine and inland. The same reasons which justified the original location of these terminals now justify their expansion. Likewise, additional pipe line facilities are being expanded by looping and by the addition of pumping stations. Generally speaking, new pipe lines to transport crude or products are built only when, for various reasons, the same results cannot be achieved by expanding existing facilities.

When war comes, and if with it comes the atomic bomb, the refinery industry because of its concentrated nature will be in an unenviable status if it is selected as a high priority target objective. It is unlikely that atomic bomb production can achieve, at least in our time, anything like mass production.

Therefore, it will be used only against choice targets. The degree of concentration in the production and transportation end of the oil industry is not such as to provide choice targets. Mobilization centers, aircraft plants, shipyards, governmental and population centers are fore-ordained to be primary targets.

Will the petroleum refinery industry be a high priority target for an enemy possessed of a limited supply of atomic weapons? We have already seen that it is so extremely concentrated as to be highly vulnerable. Certain areas of concentration present unit targets of a high percentage of our total petroleum industry refining capacity. Furthermore, no enemy will long overlook the industrial nature of the refinery surroundings. Effectiveness of an attack against the refineries may well be compounded through damage to surrounding industrial facilities, which in many areas are key industries.

The Secretary of Defense has publicly acknowledged before an open hearing of the Armed Services Committee of Congress that in the event of war we must have at least 2 million barrels per day more production than the continental U. S. is capable of yielding. At the peak of a raging war, at the time when our planes, warships, tanks, and all the myriad of petroleum-powered tools of the American way of battle begin to cast the shadow of despair upon the foe, he will not overlook the source of all this energy. The refineries are so logistically important that their destruction would be directly and immediately reflected on the field of battle. Destiny has it that the refining industry must face attack by atomic bomb, if war should come.

### Destruction Factors

The amount of destruction that the atomic bomb could accomplish against us would depend upon the area selected, the number of bombs available for the operation, and the enemy's ability to place accurately such attacks. The effect of exploding an atomic bomb over a refinery must be based on theoretical and interpolated data inasmuch as oil refineries were not included in the devastated areas of Nagasaki and Hiroshima. The heavy steel in buildings at Nagasaki suffered severe damage from blasts alone over an area of 1.8 miles in diameter. An area of this size would be sufficient to cover the major production units of most refineries.

The result is that the principal installations such as cracking coils, distillation units, and alkylation plants would be exposed to heavy and concentrated damage rather than the scattered and relatively easily repaired damage which resulted from World War II conventional bombs. It should be noted that the individual area of effectiveness of the atomic bomb is probably 5000 to 15000 times the area of effectiveness of the conventional bomb. The light steel characteristics of tank farm construction is such that the area of structural damage to them would be at least two or three times that of refinery process units. Perhaps some surcease from anxiety here can be found in development of underground storage facilities.

Successful damage control requires that the effect of damage be arrested before the cumulative results of even minor destruction goes beyond the repair ability of damage control organizations. Complete destruction of industrial facilities by using the conventional bomb usually requires an extended campaign of numerous attacks. After each attack the interim respite provides an opportunity to control damage.

On the other hand, use of the atomic bomb provides no opportunity for damage control operations during successful attacks, because it apparently is so extremely destructive that one attack virtually annihilates the target area. The refinery damage control organizations probably will find that the atomic bomb creates almost unmanageable destruction.

Before proceeding with an evaluation of the effectiveness of atomic warfare against our harbors and the results upon the operations of our petroleum industry, it is necessary to present some aspects of the needs of the petroleum industry for use of the ocean highways and of American harbor facilities.

Prior to World War II, 95 percent of the petroleum used on our East Coast involved transportation by tankers. During the war, tankers carried only 22 percent of the load after completion of the Big and Little Inch pipe lines. Today, the position again is more nearly that of pre-World War II. Statistics for 1945 show that approximately 1 million short tons of crude and finished products, amounting to roughly 7 million barrels, were moved daily by tanker in and out of our ocean terminals in domestic and foreign trade. The amount moved today, due to certain market recessions and postwar changes in the export-import pattern, is about 500,000 short tons per day, amounting to about 3½ million barrels. However, in event of emergency this slack would disappear, and the actual movements would approximate or surpass the 1945 movements.

As previously stated, the Secretary of Defense has acknowledged that the U. S. needs for petroleum in an emergency are 2 million barrels per day above the now predictable production capacity within the continental U. S. This astounding figure is 34.5 percent above current American production capacity, which until recently has been straining to the ultimate and currently striking an all-time high. If we can succeed in time of war in maintaining access to foreign sources, our war machine will want to take from those areas, 2 million barrels per day which are not available in our own country. Add this import requirement to the 7 million bpd in 1945 moved daily by tanker in and out of our ocean terminals, and it can readily be understood how vital our harbor facilities are to the operation of the American petroleum industry.

The problem of whether or not the sea lanes will be kept open, so that tankers may actually reach the harbors, is beyond the purview of this article, since it is not considered a matter of atomic warfare. There have been acknowledged technical developments in aerial and submarine warfare that present grave defense problems. The advent of the snorkel submarine and the fast underwater submarine unquestionably pose a dire threat to our maritime lifelines. Un-

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doubtedly the defensive technique against these modern submarines is under constant high priority study. However, whether or not our harbors will be available for use once the seas are successfully traversed is definitely related to development in atomic warfare.

What is the possibility of atomic warfare against our harbors, and what effect would it have on our ability to import needed supplies? Most American ports are notable because of their tremendous size. For example, the port of New York has 770 miles of waterfront, of which only 350 are developed. When we consider that one atomic bomb can destroy steel frame buildings only within an area of four square miles, it can be seen that a tremendous number would be needed against this one port alone. Even if an aggressor were to possess the weapon in quantity, the cost to destroy completely as a harbor a port such as New York would be fantastic.

The effect of the air blast damage rendered by atomic weapons against our ports would be of the same type, although much more intense than the damage rendered against the ports of our enemies by conventional bombing in World War II. If the blast occurred under water, additional damage would be caused by tidal waves and by radioactivity. The employment of a large number of atomic bombs on a port probably would produce enough radioactivity to force the evacuation of the area.

The U. S. has approximately 62 major ports capable of handling an estimated 18 million long tons per month of dry cargo under normal working conditions. This capacity could be increased to an estimated 25 million long tons per month by the more effective use of lighterage and the more intensive use of alongside facilities to reduce the turnaround time of vessels. At present, less than 50 percent of our potential port capacity is being used. With particular regard to petroleum, approximately 30 million short tons of petroleum and its products per month were moved into and out of our Atlantic, Gulf, and Pacific ports in 1945. The unused and expandable capacities represent a cushion that can be used to absorb much of the effect caused by an atomic weapon attack.

Also, the use of alternate ports should permit to a great degree the continuation of effective movement of essential shipping, and if the worst should come tankers can be anchored offshore and floating lines used to carry on loading or discharge.

In conclusion, it must be admitted that the highly concentrated nature of the U. S. refining industry is such that it is vulnerable in a major sense to atomic warfare, and that it is a choice target susceptible to classification by the enemy as a target objective of high priority.

As for our harbors, they are of such great size and numbers, and the use of alternate ports and expediencies in loading and discharging tankers is so readily available, that even the atomic bomb is not likely to do more than cause temporary closing down of a given port or portions thereof, or disruptions in petroleum handling. The net effect on tanker operation or other aspects of petroleum distribution will not be sufficiently substantial to critically hinder oil industry operations.

## *Manpower Shortage*

■ CONTINUED FROM PAGE 63

roughnecks. In addition, he said, the 40-hour week is "definitely running my operating costs up to a dangerous level."

Apparently, West Texas contractors are in no better shape. One firm whose headquarters are in Fort Worth said 1146 employes were on its rolls in 1950. When compared to the 450 normally required to operate rigs and offices, the figure evidences a huge turnover. An official said its biggest turnover occurred during the first half of 1951, when 5266 men left its drilling crews. Seventy-seven percent resigned to take other jobs. Nine percent were discharged, and 14 percent were laid off. However, those who were laid off for a short time failed to return to work when called again.

The turnover in this company also was compounded by "considerable difficulty in obtaining trained men during the latter part of 1950 and the first part of 1951." This firm also pointed to an expected further migration to the "bright lights," where the accelerated mobilization program has established additional jobs with regular hours.

"Most of these newly-created jobs are manual," a company official said, "and the oil field workers who have learned to work with their hands certainly make better men for these jobs than the common laborers."

And still another West Texas operator said, to his knowledge, "everyone is faced with the difficulty of obtaining trained men, especially in West Texas, as the pool of experienced men in that area is not large enough to take care of the increased drilling now going on."

A typical reply to the query as to whether there exists a labor shortage among drilling crews in Oklahoma and Kansas is:

"Men are plentiful; the real difficulty is in getting pipe. We can get all the men we need and wish it were as easy to get pipe and other equipment."

Another contractor reported from his Oklahoma headquarters: "As long as we keep our rigs busy, we have very little turnover. Looking over the payrolls for the past five years, we find that they are much the same today as they were then. Pay rates are attractive to crewmen, and with the exception of an occasional married man who wants to settle down for the sake of his family, we manage to keep the same crews."

Another optimistic note was sounded by the vice president of a Tulsa contracting firm:

"We have labor shortages in the Rocky Mountain and West Texas areas, but this is to be expected since drilling is at peak levels in those areas. But as for our regular men leaving to go into other lines of work, we do not think this happens very often. The shortage in personnel is among the more experienced men. I believe there is more 'swapping' of crews from one drilling contractor to another than there is actually quitting to get into something else."

Additional reports emanating from Rocky Mountain, Kansas and Oklahoma sectors referred to no more than normal turnover and included no forecast of labor trouble.

California, too, is experiencing little labor supply trouble. Seven California contractors spoke of the lack of training of crewmen as their No. 1 problem. Nearly all agreed the armed forces had taken some of their good men; however, few blamed defense industries for siphoning off their crewmen.

One Californian summed it up this way: "Here in California, there have been a number of war plants that have continued operations down to the present, so contractors always have had the competition of those plants in securing labor. The Mid-Continent conditions might be a little different in that war plants just now re-opening are offering more attractive pay with more regular hours."

At what point the labor problem will ease for contractors in the "difficult" zones is unknown. The contractors don't know; they are only hoping for an economic leveling off which, in some way, will erase the factors which have pushed them into such a precarious position.

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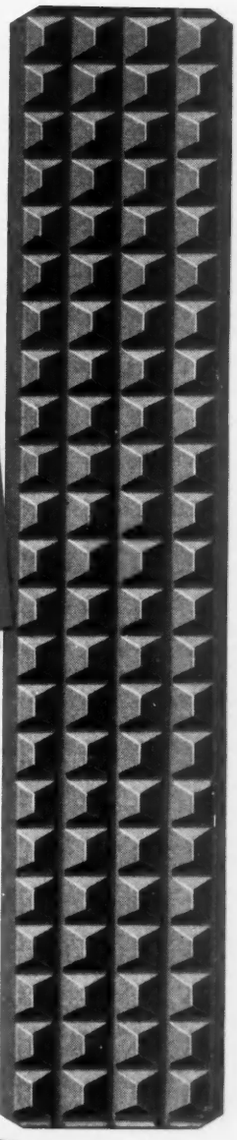

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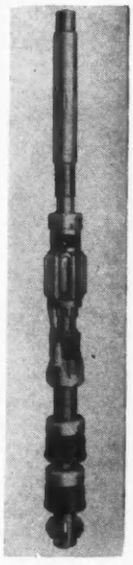
# NEW AND IMPROVED EQUIPMENT

## SUPPLEMENTING COMPOSITE CATALOG

**KEEP INFORMED by requesting additional information on new equipment and services described on this and following pages. SAVE TIME by using one of the free and convenient Reader Service Postcards on opposite page. Circle number on card corresponding to the number listed at the end of each new equipment item on which you desire additional information.**

## Hold Down Packer



**This item supplements The Guiberson Corporation data on pages 2013-2080 of Composite Catalog, 18th Edition.**

A hold down packer with an automatic latch, Type "AHD", is available from The Guiberson Corporation. The packer is designed for acidizing or injecting fluids into formations below the packer, and any other job where tubing pressure is greater than annulus pressure. All-metal latching dog, corrosion-resistant springs, and the anti-lock mechanism assure positive control of slips when setting or pulling. A telescoping valve equalizes tubing and casing fluid. Workover operations using the Hydrafrac process showed the packer holding pressures over 3000 pounds per square inch and localizing the fluid until the treatment was completed.

*Circle No. 15 on Postcard*

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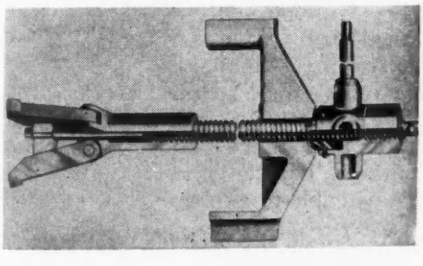
## Liner Puller

**This item supplements Grant Oil Tool Company data on pages 1953-1976 of Composite Catalog, 18th Edition.**

Pullers made by Grant Oil Tool Company remove liners from slush, feed-water, or any other pumps equipped with removable liners. Exclusive of the yoke, the few parts of which each puller is comprised are permanently integrated. One yoke covers the entire range of sizes for each puller, and the yoke has an open slot which makes it unnecessary to run the nut the full length of the screw each time a liner is pulled. The nut assembly incorporates a roller thrust bearing with a reinforcing support which prevents distortion of the bearing in the section of the yoke through which the screw travels. Two sizes handle all liners from 3½- to 9-inch.



*Circle No. 16 on Postcard*

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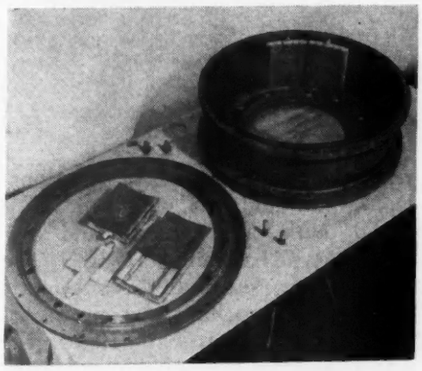
## Air Clutch

**This item supplements The National Supply Company data on pages 3501-3632 of Composite Catalog, 18th Edition.**

The National Supply Company's new drum type air clutch, the Ideal Dy-A-Flex, is now standard equipment on five drilling rigs in one to three positions. As illustrated, the



ring-shaped air chamber between clutch housing and rubber diaphragm is sealed by flanges of the diaphragm which are squeezed between side plates and internal flanges of the housing. Unitized brake shoe assemblies with large air passages have Manhattan Keylocks with new thin molded block type of lining. Linings may be replaced without removing the clutch housing from the drive shaft by removal of the end plate.

*Circle No. 17 on Postcard*

## Cutting Machine

**This item supplements Air Reduction Magnolia Company data on page 159 of Composite Catalog, 18th Edition.**

The Airco No. 50 Travograph is the latest addition to Air Reduction Magnolia Company's line of gas cutting machines. Guided by a manual, magnetic or electronic tracer, the new pantograph type cutting machine will cut an unlimited variety of shapes from steel plates, slabs, billets and forgings. It is of all welded, heavy gauge steel construction.

*Circle No. 18 on Postcard*

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## Rod Elevator

**This item supplements Web Wilson Oil Tools, Inc., data on pages 5161-5184 of Composite Catalog, 18th Edition.**

Sucker rods and polished rods can be handled without danger of kinking, distortion or dropping the string, with the rod elevators made by Web Wilson Oil Tools, Inc., the manufacturer claims. The elevators have no protruding latches, and the rod seats are machined to fit the contour of the rod. They are balanced to suspend the rod string vertically, and the forged bail is reinforced at the top where strength is needed. The elevators are instantly reversible, and latches can be operated from either front or rear.

*Circle No. 19 on Postcard*

# NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

**To obtain additional information use convenient Reader Service Postcard on page 71. Circle number on card corresponding to the number listed at the end of each equipment item on which more information is wanted.**

## Hoist-Binder

**This item supplements Coffing Hoist Company data on page 1269 of Composite Catalog, 18th Edition.**

A load binder working on the ratchet hoist principle, the Hoist-Binder made by Coffing Hoist Company will take up or slack off a load chain any amount up to 20½ inches. If a load settles in transit, the new unit may be tightened without the necessity of releasing the entire load to take a new "grab." Full strokes can be used for rapid take-up; half strokes permit minute adjustments. The binder chain may be pulled freely through the ratchet when not under load. The Hoist-Binder weighs only ten pounds and will exert a pull of 3000 pounds, the manufacturer claims.

*Circle No. 20 on Postcard*

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## Beam Pumping Unit

**This item supplements Pelton Water Wheel Company data on pages 4171-4178 of Composite Catalog, 18th Edition.**

Augmenting its line of long stroke hydraulic pumping jacks, Pelton Water Wheel Company is now offering a new beam pumping unit in various sizes. Pelton acquired the line of Pacific Western beam pumping units and redesigned them after a survey of field needs. The new beam pumper has a weight counterbalance adjustment by which one man may change the counterbalance.

*Circle No. 21 on Postcard*

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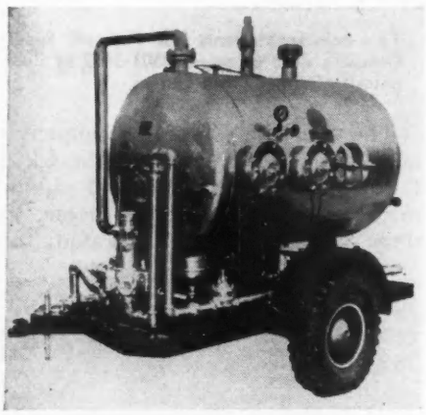
## Well Testing Unit

**This item supplements Rolo Manufacturing Company data on pages 4418-4419 of Composite Catalog, 18th Edition.**

A new Rolo Wellchecker, Type No. 1 H-4806, is a portable well-testing unit with a 48-inch outside diameter x 6 feet seam-to-seam x 150 pounds per square inch working pressure horizontal oil and gas separator. It is piped, with orifice fitting and diaphragm type back pressure valve. The Wellchecker also has an automatic free water knockout, by means of which free water is segregated in the water compartment of the separator, its level controlled by a weighted float, and water is metered by water meter when discharged from the separator. Additional oil meters are available manifolded in parallel to enable the unit to handle high rates of oil flow. Available either trailer or skid mounted, the large-capacity unit provides means for making periodic well tests, drill stem tests, and potential tests, and for determining gas/oil ratios and other data.



*Circle No. 22 on Postcard*

## Hook-Block

**This item supplements The National Supply Company data on pages 3501-3632 of Composite Catalog, 18th Edition.**

Designed to effect maximum saving in vertical derrick space, a new Ideal hook-block made by The National Supply Company is a combination traveling block and spring-loaded hook and connector. It is built in three sizes with working capacities of 90, 140 and 200 tons. It may be used as a hook to support the swivel bail directly, or the drilling string may be supported by the elevator with elevator links connected to the hook link support. All bolts, nuts, pins and grease fittings are recessed to eliminate dangerous projections. Sheaves are independently mounted on tapered roller bearings, each sheave held in a fixed lateral position.

*Circle No. 23 on Postcard*

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## Polished Rod Clamp

**This item supplements Altens Foundry & Machine Works, Inc., data on pages 189-208 of Composite Catalog, 18th Edition.**

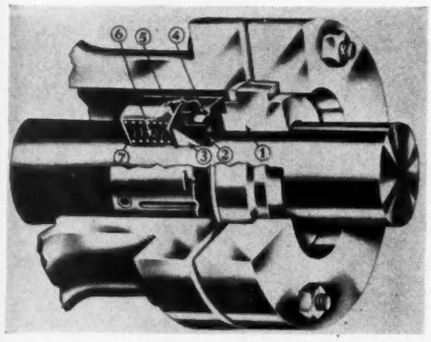
A longer and weatherproof nut has been added to the Wonbolt polished rod clamp made by Altens Foundry & Machine Works, Inc. The new nut keeps out ice, mud and snow, and gives added wrenching surface. The clamp with the new nut is available in two sizes.

*Circle No. 24 on Postcard*

# OTHER NEW AND IMPROVED EQUIPMENT

**KEEP INFORMED by requesting additional information on new equipment and services described on this and following pages. SAVE TIME by using one of the free and convenient Reader Service Postcards on page 71. Circle the number on card corresponding to the number listed at the end of each new equipment item on which more information is wanted.**

## Mechanical Seal




Crane Packing Company's new high temperature, anti-corrosive Type B mechanical seal incorporates a Teflon "wedge-ring" sealing member. The set-screwed metal retainer (7) provides a positive drive from shaft to carbon sealing washer (2) through dents (4) which fit into washer notches. An effective seal between shaft and washer is provided by Teflon ring (3) which is preloaded by action of multiple springs (6). Spring pressure is uniformly distributed by metal disc (5). The lapped raised face of rotating sealing washer (2) mates against the highly lapped face of the stationary seat (1) to provide a positive leak-proof seal.

*Circle No. 25 on Postcard*

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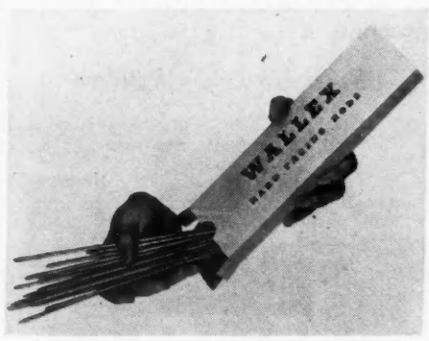
## Hard Facing Rod

Wall Colmonoy Corporation's new hard facing rod, Wallex, is an oxy-acetylene rod for abrasion resistance, and has impact and corrosion resisting properties. It is composed of chromium, molybdenum, manganese, silicon, carbon and iron.

*Circle No. 26 on Postcard*




## Perforating Service

Jeep-Jet perforating service, offered by Welex Jet Services, Inc., makes use of the new twin-jet charge, which is based on the shaped charge principles of the original Welex jet perforating process. Jeep-Jet penetration is not quite so great as the regular jets, but the average depth is greater than with bullets, Welex claims. Firing ports of the Jeep-Jet gun are arranged in pairs diametrically opposite on 90-degree phasing spaced for positive density of either 4, 6 or 8 holes per foot. The guns are made in 4 and 5-inch o. d. Assembly of guns in double or triple sections makes possible a maximum number of holes per run when conditions permit. The charges are loaded with an explosive that gives a penetrating jet velocity of more than 30,000 feet per second.

*Circle No. 27 on Postcard*

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## Safety Goggle Pliers

Two new safety goggle pliers which simplify and speed the replacing of side-shields on spectacle type safety goggles are made by American Optical Company. The pliers, called the 169 Rivet Knockout plier and the 170 Riveting plier, are designed so that inserting or removing goggle rivets can be accomplished without removing lenses.

*Circle No. 28 on Postcard*

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## Paraffin Removal

Magnusol, an emulsion solvent cleaner made by Magnus Chemical Company, speeds removal of paraffin deposits from well tubing, the company claims. In practice, ten gallons of Magnusol concentrate are mixed with 60 gallons of kerosine and the solution is poured down the tube. After 45 minutes, the paraffin is softened enough for the scrapers to go to work.

*Circle No. 29 on Postcard*

## Pressure Control

A new electrical control device made by Sola Electric Company maintains constant pressure on oil and gas pipe lines. The Sensivolt is a static AC voltage sensitive control or circuit which can be set to respond to either unplanned fluctuations of line voltage or to deliberate voltage modulation. Sensitive to changes as small as one-half volt, the control can be used to start auxiliary electrical equipment which voltage falls too low to operate a specific machine.

*Circle No. 30 on Postcard*

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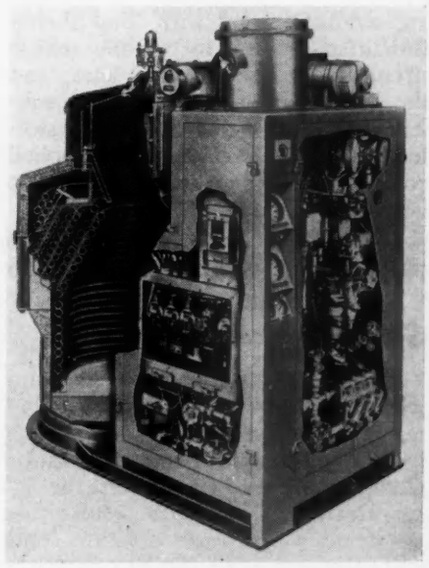
## Steam Generator



Vapor-Clarkson steam generator, Model 4740, is now adaptable to supply 600 pounds pressure dry steam to melt paraffin in pipes from portable rigs. The steam generator, made by Vapor Heating Corporation, develops 200 pounds steam pressure in two minutes from 50° F. water, and produces 4800 pounds of 99 percent dry steam per hour, 82 percent efficient. One electric motor (or gasoline engine on portable units) drives the water pump, fuel pump, blower and magneto.

*Circle No. 31 on Postcard*

# OTHER NEW EQUIPMENT

**To obtain additional information use convenient Reader Service Postcard on page 71. Circle number on card corresponding to number listed at the end of each new equipment item on which more information is wanted.**

## Asphaltic Coating

Dica-Rode, a new asphaltic coating made by The Zone Company, provides underground pipe and foundations with protection against corrosive elements in the earth. Two forms are available: one with long-fibered Canadian asbestos for greater tensile strength, for use on pipe lines; and the other without asbestos, for subterranean portions of concrete or steel foundations. The material is applied cold, by brush or spray, at the job site.

*Circle No. 32 on Postcard*

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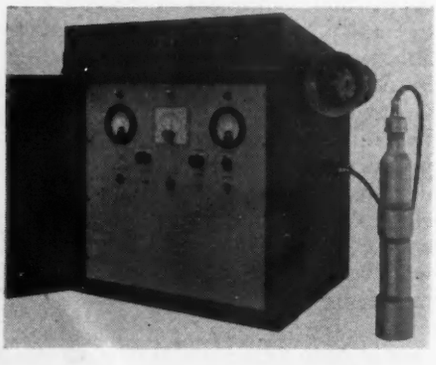
## Gas Detector-Alarm

A new semi-portable gas detector with siren alarm for use in continuous tests for hydrocarbon show in drilling wells is offered by Atlas Exploration Company. Called Rigtector, the instrument sounds an alarm when either gas or other hydrocarbon vapors come from the well head. No flow pump or air aspirator bulb are required, but a swage is inserted between the well head and the shale shaker. The actual percentage of the lower explosive limit is measured and the alarm indicator may be set for any predetermined explosive percentage.



*Circle No. 33 on Postcard*

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## Flow Meter

A new flow meter made by Brown Instruments Division of Minneapolis-Honeywell Regulator Company has an evenly graduated meter scale and electronic integration. It is available either as a mechanical flow meter with integral recorder, or as an electrical transmitter to be used with a Brown inductance bridge receiver.

*Circle No. 34 on Postcard*

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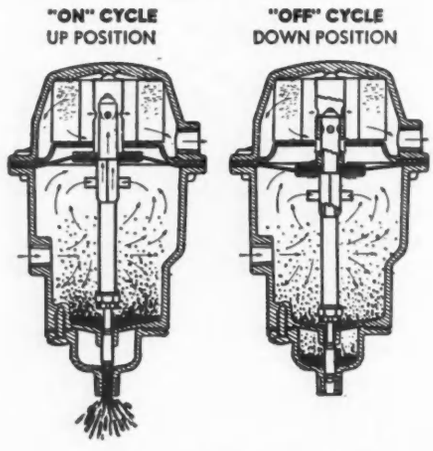
## Clean-out Valve




A new line of Wilkerson Corporation valves is available for automatic removal of contaminants and precipitates from compressed air lines, aftercoolers, sumps, tanks and air brake systems. Included in the line are automatic drains and separators. Pictured is the diaphragm operated valve. When the air line is not in use the diaphragm is forced down by back pressure with the O-ring sealing the sump bottom. As air is used the pressure differential raises the diaphragm and shaft, seals bottom of middle chamber, opens bottom of sump and blasts out contamination.

*Circle No. 35 on Postcard*

## Microwave Parabola Control

RCA Victor's new system for controlling microwave parabolic antennas in the field at distances up to 1500 feet permits rigid positioning from a remote location. The system consists essentially of a rotatable field mount and a remote control unit equipped with switches and indicating devices. The field mount permits both azimuth and tilt positioning of the parabola. The reflector may be rotated 370 degrees in azimuth or tilted 15 degrees up and 30 degrees down.

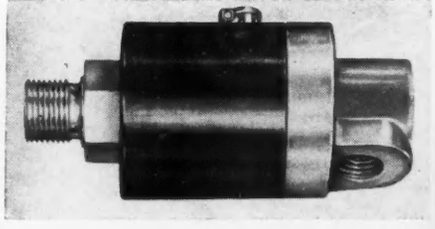
*Circle No. 36 on Postcard*

•

## Air Union

A new rotating air union, Model 1105, with a new method of balanced sealing and simple maintenance, has been introduced by the Deublin Company. Micro-lapped faces of Graph-Mo tool steel and carbon form the leakproof seal. Housing and end bell are of aluminum for light, rigid construction.

*Circle No. 37 on Postcard*



# "Super 46..."

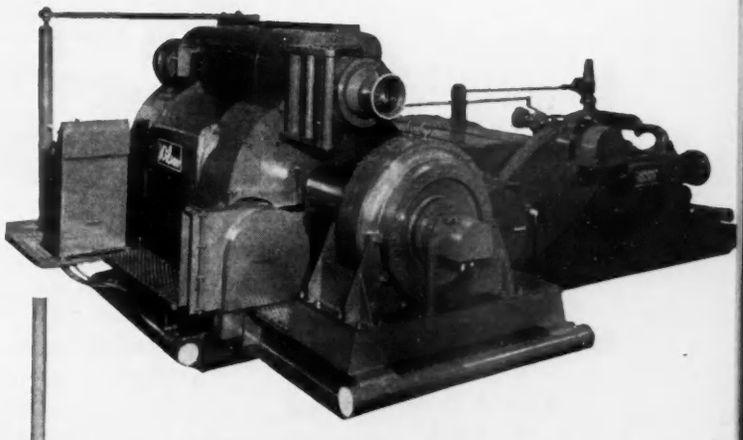
## the new, POWERFUL HYDROMATIC for SUPER Performance

• The outstanding feature of this new Parkersburg 46" single rotor Hydromatic Brake is its greatly increased power at low speeds. It develops 7000 HP at 4000 RPM; 4700 HP at 350 RPM. It will hold a 200,000 lb. load to a speed of 90' in 19 seconds when operating at full capacity on a drawworks with a drum diameter of 30" and 8 lines. It packs all the power you need to meet any braking problem encountered in 20,000 foot drilling.

Increased power and improved performance isn't the whole story. Although it has over 30% more braking power than the 40" double rotor Hydromatic, the "Super 46" is available at the same price. Here is a value you can't afford to overlook when installing a drawworks brake.

Like all Hydromatics, the "Super 46" has all the safety advantages and exclusive features that have made them the industry's greatest development in drawworks braking power. Ask your Parkersburg Representative about the Hydromatic for your drawworks . . . there's a size for every need.

• For even greater safety, dependability and ease of operation, we recommend your Hydromatic be equipped with an overrunning clutch. Ask for details.



• Wilson Steamair Drawworks equipped with the new Parkersburg "Super 46" Hydromatic.

No. 5115

**PARKERSBURG**

**RIG & REEL COMPANY** • Parkersburg, West Virginia

# NEW LITERATURE

**Copies may be obtained easily and without cost by using Reader Service Postcard. Just circle on the card the number at the end of each item in which you are interested. The convenient Postcards are on page 71.**

## Induction Motors

Data on ratings, construction and types of large Allis-Chalmers vertical induction motors are contained in a new bulletin. Motors described are available in ratings upwards from 60 horsepower at 200 revolutions per minute.

*Circle No. 38 on Postcard*

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## Crawler Tractors

Fleet Applications of International TD-24 diesel crawler tractors are presented pictorially in an eight-page folder published by International Harvester Company. There is also a listing of mechanical features of the 148 drawbar horsepower International crawler.

*Circle No. 39 on Postcard*

•

## Tubing Swabs

Tubing swabs made by Bell Rubber Company are discussed in two new bulletins. Model 50, which has cups assembled on mandrel, is discribed in one folder, which another treats of models 10, 20, 210, 40 and 410, which have reversible swab cups.

*Circle No. 40 on Postcard*

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## Measuring Instruments

Information on how to select electrical measuring instruments is provided in a new 30-page instrument booklet by Westinghouse Electric Corporation. Seven basic selection factors are explained, and various instruments are illustrated.

*Circle No. 41 on Postcard*

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## Swivel-Bail

Procedure for converting a conventional swivel-bail to the Ideal connector type swivel-bail is given in a new publication of The National Supply Company. The bail can be adapted for use with any elevator.

*Circle No. 42 on Postcard*

THIS FIELD-WORN HOOK HAS LOST ITS STUFF...
BJ BUILDS IT UP TO SNUFF
BJ
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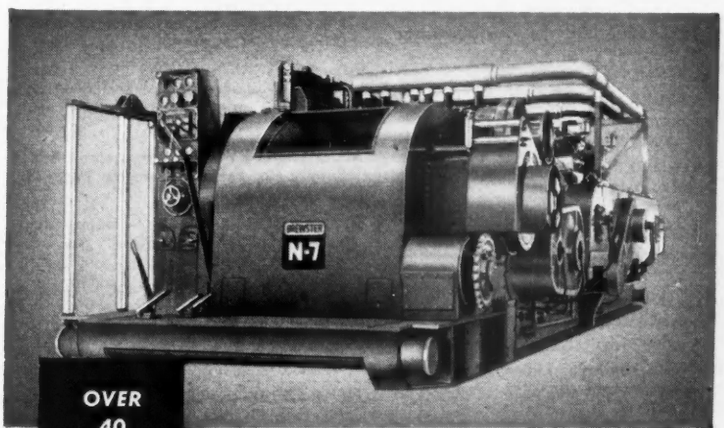


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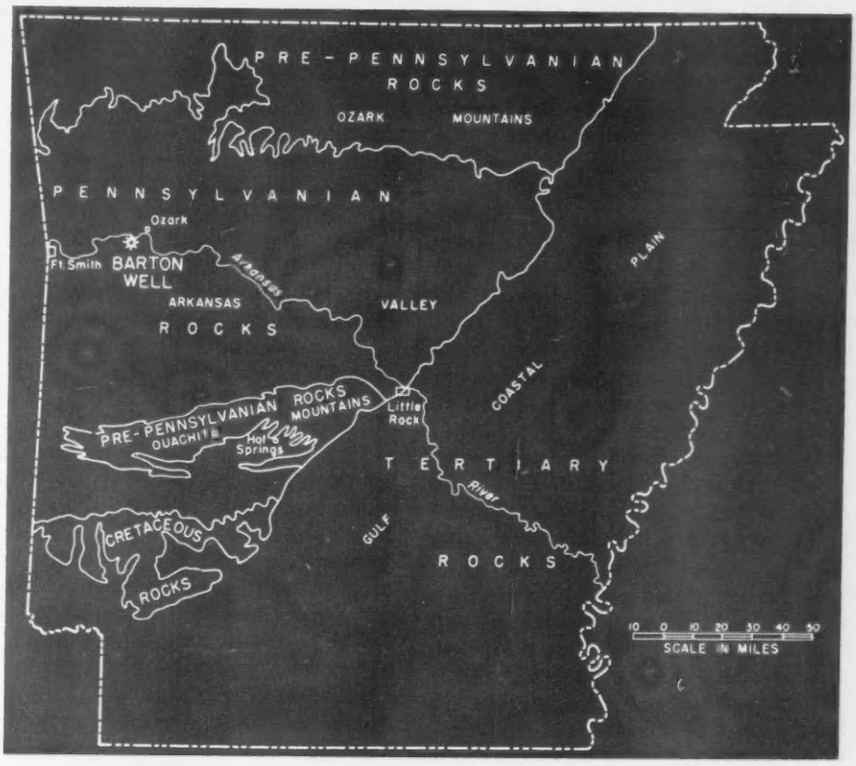
By ROBERT J. LANTZ
U. S. Geological Survey
Tulsa




Generalized geologic map of Arkansas showing location of Barton well.

# Stratigraphy of Key Arkansas Deep Test

WITH completion of Arkansas-Louisiana Gas Company's Barton 1, SE SE SW 27-9n-28w, Franklin County, Arkansas, an unusually accurate and complete record of the deeply buried formations below the gas-producing sands of the Arkansas Valley became available to geologists and oil operators and probably will encourage more wildcats in the comparatively unknown area of central-northern Arkansas.

The well also marks the discovery of the first commercial gas field in Arkansas from lower Pennsylvanian Morrow rocks. Drilled to 6650 feet, total depth, before being plugged back to 5000 feet, the test penetrated rocks of Pennsylvanian, Mississippian, Devonian, Silurian and Ordovician age.

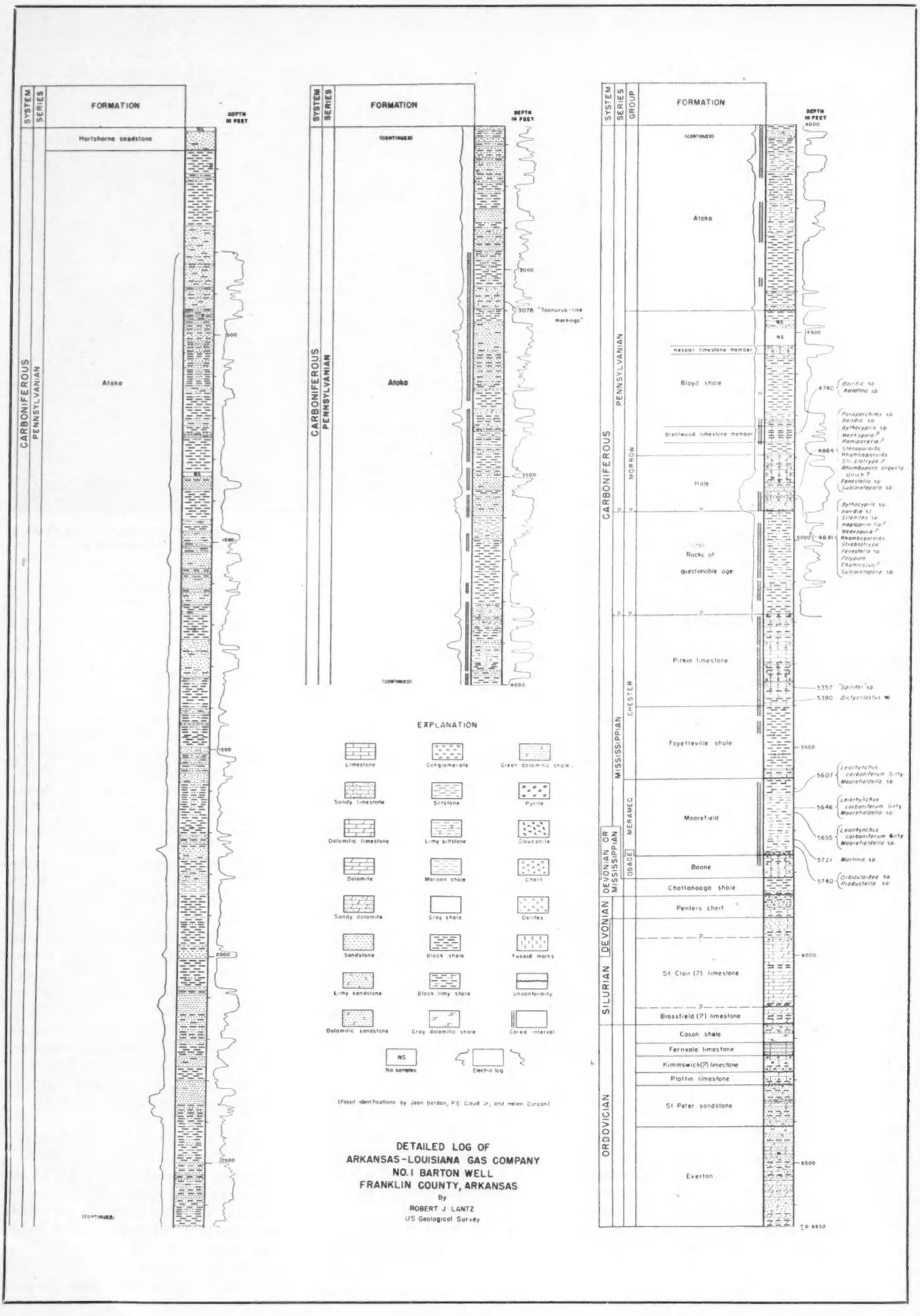
The importance of this test is that it serves as a key point for future correlations and stratigraphic studies in this area. Lack of such knowledge has seriously hampered deep wildcat drilling in what may become an important oil- and gas-producing province in the Mid-Continent region.

The Arkansas-Louisiana Gas Company, cooperating with the Arkansas Division of Geology, turned over to the latter the major portion of the diamond core section and all well cuttings, all of which are now available to those desiring to check some of the correlation points. Almost continuous cores were obtained from the middle of the Atoka formation (Pennsylvanian) to the top of the Boone formation (Mississippian) and excellent cable tool cuttings of the formation not cored were collected.

Herewith is presented the stratigraphic determination of the subsurface as revealed from a study of the cores and cuttings from the Barton test. The information is from Bulletin 18: "Geological Formations Penetrated by the Arkansas-Louisiana Gas Company No. 1 Barton Well on the Cecil Anticline, Franklin County, Arkansas," published in cooperation with the U. S. Geological Survey, Little Rock. The detailed lithologic description of the cores and cuttings is omitted but is contained in Bulletin 18.

DRILLING DATA: The Barton 1 was spudded November 14, 1948, and completed September 26, 1949. Cable tools were used from the surface to a depth of 2860 feet; rotary tools from 2860 to 5783 feet, and cable tools again from 5783 to 6650 feet, total depth. Samples of drill cuttings were collected at five- and 10-foot

**ARKANSAS-LOUISIANA GAS COMPANY'S Barton 1, Franklin County, Central-Northern Arkansas, has furnished a valuable record of formations below the gas producing sands of the Arkansas Valley. Drilled to 6650 feet, the test penetrated rocks of Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician age. The well will serve as a key point for correlations and stratigraphic studies in the area. Plugged back to 5000 feet, the well also marks discovery of the first commercial gas field in Arkansas producing from lower Pennsylvanian Morrow rocks.**


SYSTEM
SERIES
FORMATION
DEPTH IN FEET
CARBONIFEROUS
PENNSYLVANIAN
Hartshorne sandstone
Atoka
(CONTINUED)
(CONTINUED)
5078 "Taonurus-like markings"
EXPLANATION
Limestone
Conglomerate
Green dolomitic shale
Sandy limestone
Siltstone
Pyrite
Dolomitic limestone
Limy siltstone
Glauconite
Dolomite
Maroon shale
Chert
Sandy dolomite
Gray shale
Oolites
Sandstone
Black shale
Fucoid marks
Limy sandstone
Black limy shale
Unconformity
Dolomitic sandstone
Gray dolomitic shale
Cored interval
NS
No samples
Electric log
(Fossil identifications by Jean Berdan, P.E. Cloud Jr. and Helen Duncan)
DETAILED LOG OF
ARKANSAS-LOUISIANA GAS COMPANY
NO. 1 BARTON WELL
FRANKLIN COUNTY, ARKANSAS
By
ROBERT J. LANTZ
US Geological Survey
GROUP
(CONTINUED)
Atoka
Kessler limestone member
Bloyd shale
Brentwood limestone member
Hale
Rocks of questionable age
Pitkin limestone
Fayetteville shale
Moorefield
Boone
Chattanooga shale
Penters chert
St. Clair (?) limestone
Brassfield (?) limestone
Cason shale
Fernvale limestone
Kimmswick(?) limestone
Platlin limestone
St Peter sandstone
Everton
PENNSYLVANIAN
MORROW
CHESTER
MERAMEC
OSAGE
MISSISSIPPIAN
DEVONIAN OR MISSISSIPPIAN
DEVONIAN
SILURIAN
ORDOVICIAN
NS
4740 Bairdia sp. Kellettina sp.
4884 Paraparchites sp. Bairdia sp. Bythocypris sp. Mckenzia? Kamporella? Stenoporoids Rhombopores Str. Liptrypa? Rhombopora angusta Ulrich? Fenestella sp. Sulcoretepora sp.
4891 Bythocypris sp. Bairdia sp. Sirenites sp. Hoplogramma? Meekopora? Rhombopores Streblotryxa Fenestella sp. Polypora Thamniscus? Sulcoretepora sp.
5357 "Spirifer" sp.
5390 Dictyoclostus sp.
5607 Leiorhynchus carboniferum Girty Moorefieldella sp.
5646 Leiorhynchus carboniferum Girty Moorefieldella sp.
5655 Leiorhynchus carboniferum Girty Moorefieldella sp.
5721 Martinia sp.
5740 Orbiculoidea sp. Productella sp.
T.D. 6650

intervals except in the sections that were cored. Coring with 3½- and 4½-inch diamond-head core barrels was started at 2958 feet in the Atoka formation and continued intermittently to 5783 feet in the Boone formation. All this interval was cored except the thick shale beds and core recovery was almost 100 percent. After reaching 6650 feet the well was plugged back to 5000 feet and was reported producing 7 million cubic feet of dry gas per day through perforations from 4850 to 4930 feet from the Hale formation.

PURPOSE OF INVESTIGATION: The surface exposures of the Paleozoic formations are well known in the Ozark region of Arkansas; they have been mapped and described in detail by numerous geologists.[1] Their subsurface equivalents are relatively unknown in the Arkansas Valley where few wells have been drilled through the Pennsylvanian rocks. The long cores, excellent samples, and electric log from the Barton well provide a wealth of detailed stratigraphic information and will aid in tracing the formational units of the Ozarks beneath the Arkansas Valley. The correlations suggested herein are only tentative because of the considerable distance from the well to the nearest outcrops. The detailed lithologic descriptions of the well cuttings and cores as contained in Bulletin 18, it is hoped, will aid in establishing more precise correlations later and in the meantime serve as a stratigraphic guide in future drilling in northwestern Arkansas.

## *Stratigraphy*

Lower Pennsylvanian and older rocks that crop out in the Ozark region of northern Arkansas dip southward under thick younger Pennsylvanian rocks in the Arkansas Valley region and appear again at the surface in the Ouachita Mountains (Figure 1). The outcrops in the Ozark region are mostly marine beds of limestone, dolomite, and shale; the rocks exposed in the Ouachita Mountains are mostly continental and nearshore deposits of sandstone and shale. The rocks penetrated by the Barton well in the northern part of the Arkansas Valley (Figure 1) resemble the Ozark section and not the clastic sequence of the Ouachita Mountains. This well, on the south flank of the Cecil anticline as mapped by Hendricks and Parks,[2] penetrated rocks of every age from Pennsylvanian to Ordovician. A short description of these rocks follows, beginning with the youngest.

## *Carboniferous System*

### Pennsylvanian Series

The Hartshorne sandstone, a white micaceous fine-grained sandstone, extends from the surface down to a depth of 55 feet. The light color of the Hartshorne sandstone distinguishes it from the underlying gray sandstones of the Atoka formation. Although the Hartshorne and the Atoka are separated by an unconformity, no evidence of it was seen in the samples.

The Atoka formation, 4392 feet thick, consists of alternating beds of sandstone, siltstone and dark shale. The beds of siltstone and silty shale in the lower 1500 feet of the Atoka are remarkably fucoidal, the fucoid marks making a delicate pattern of whorls and scrolls on the outside of the cores. Probably more of the formation is fucoidal, but only the lower 1500 feet was cored and fucoid marks could not be recognized in cuttings. The base of the Atoka formation is marked by a light-gray limy fine-grained sandstone. The only Atoka fossil collected was identified by P. E. Cloud, Jr., of the U. S. Geological Survey, as "a Taonurus-like marking." The unconformity which separates the Atoka formation from the underlying Bloyd shale was not recognized in the samples.

### Morrow Group

A succession of thick black shale beds, thin sandstone and siltstone layers, and two limestone members—the Kessler limestone member and the Brentwood limestone member—constitute the Bloyd shale. The Kessler limestone members near the top of the formation is 21 feet thick. It is overlain by a sequence of black shale and sandstone, 84 feet thick, and underlain by a bed of limy fine-grained sandstone, ten feet thick, and a sequence of black shale and siltstone, 163 feet thick. The Brentwood limestone member, which is next in the downward sequence, is a dark-gray argillaceous crinoidal limestone, 37 feet thick, underlain by a bed of black silty shale, 31 feet thick. Ostracodes from the Brentwood limestone were identified by Jean M. Berdan of the U. S. Geological Survey as: *"Bairdia* sp., *Kellettina* sp., also a subrhomboidal form possibly referable to *Ectodemites,* and a smooth form with a posterior keel apparently related to *Healdia."* The Bloyd shale overlies the Hale formation conformably.

The Hale formation, 136 feet thick, consists of limestone, shale, and sandstone. The upper part of the formation is composed of gray oolitic fossiliferous slightly glauconitic porous limestone, 113 feet thick, which includes a few thin beds of black shale and limy sandstone. Below the limestone is a bed of porous white fine-grained sandstone, 23 feet thick, at the base of which is a brown phosphatic conglomerate. Bryozoa from the Hale formation were identified by Helen Duncan of the U. S. Geological Survey as: *"Meekopora?, Ramiporalia?,* stenoporoids, *Streblotrypa, Streblotrypa?, Rhombopora angusta* Ulrich?, other indeterminate rhomboporids, *Fenestella* sp., *Fenestella* sp. possibly F. *multispinosa* Ulrich, *Polypora, Thamniscus?, Sulcoretepora* cf. S. *simulans* (Ulrich), *Sulcoretepora* sp. indet." Ostracodes from the Hale formation were identified by J. M. Berdan of the U. S. Geological Survey as: *"Paraparchites* sp., *Bairdia* sp., *Bythocypris?* sp., *Silenites* sp., and a unisulcate form similar to *Haploprimitia."*

Rocks of Questionable Age. Below the conglomerate at the base of the sandstone and overlying the massive Pitkin limestone of Chester age is a 252-foot sequence of black siltstone, limestone, and shale, which the writer is unable to assign with certainty to either the Morrow or Chester group. This sequence can be split into two lithologic units—an upper unit, 175 feet thick, composed of beds of fucoidal shale and siltstone, and a lower unit, 77 feet thick, composed of a thin bed of dark-gray argillaceous limestone and a thick bed of black shale. Lithologically, the core of the upper unit resembles parts of the Atoka formation penetrated higher in the well, whereas the lower unit is more similar to the underlying beds of Chester age. No evidence of an unconformity was found in or below this sequence. A similar sequence on the surface in northern Arkansas was mapped by Miser[3] with Morrow rocks, but it appears that beds similar to the lower unit have been included in the Pitkin limestone in northeastern Oklahoma by Moore.[4] Whether any part of the sequence is equivalent to the Springer formation is not known as no identifiable fossils were found in this part of the core.

## *Mississippian Series*

### Chester Group

The Pitkin limestone, 218 feet thick, consists of dark finely crystalline fossiliferous limestone which contains oolitic layers. Fossils from the Pitkin limestone were identified by P. E. Cloud, Jr., of the U. S. Geological Survey, as *"Spirifer"* cf. *S. keokuk* Hall, and *Dictyoclostus* cf. D. *inflatus* (McChesney)?. The Pitkin rests conformably upon the Fayetteville shale.

The Fayetteville shale, 177 feet thick, is composed of a thick black

shale bed which includes two thin limestone beds near the base. No evidence of the unconformity separating the Fayetteville from the underlying Moorefield formation was seen in the samples.

### Meramec Group

The Moorefield formation consists of an upper black shale bed, 40 feet thick, and a lower black calcareous argillaceous siltstone bed, 144 feet thick. Rocks resembling the Batesville sandstone or the Hindsville limestone member of the Batesville sandstone which overlie the Moorefield formation at some places were not present in the well. A basal conglomerate, which contains black chert pebbles and abundant glauconite, marks the unconformable contact of the Moorefield and the underlying Boone formation. Fossils from the Moorefield formation were identified by P. E. Cloud, Jr., of the U. S. Geological Survey as follows: "*Leiorhynchus carboniferum* Girty, *Moorefieldella* aff. *M. eurekensis* (Walcott), *Martinia* sp., *Orbiculoidea* sp., *Productella* cf. P. *hirsutiformis* Walcott."

### Osage Group

The Boone formation is composed of gray finely crystalline limestone with much interbedded and included chert which is dark-colored and highly fractured at the top, gray in the middle, and cream-colored at the bottom. A comparatively thin section of Boone, 52 feet, was penetrated in the well. The Boone formation is reported to rest unconformably on the Chattanooga shale from surface exposures.

### Carboniferous (Mississippian or Devonian System)

The Chattanooga shale is made up of a black shale bed, 41 feet thick, which includes a thin calcareous sandstone near the base. The unconformity between the Chattanooga shale and the underlying Penters chert could not be discerned from the cuttings.

## *Devonian System*

The Penters chert, which totals 58 feet in thickness, is composed of an upper unit of milky chert and thin interbedded limy siltstone layers, 33 feet thick, and a lower unit of gray coarsely crystalline limestone, 25 feet thick. The Penters chert is reported to rest unconformably on Silurian rocks.

## *Silurian System*

Limestones and dolomitic limestones totaling 258 feet thick represent the Silurian system in the well. The upper part of the limestone sequence, which lies unconformably below the Penters chert, has not been correlated. This portion of the sequence is a white silty finely granular limestone, 48 feet thick, which occupies the stratigraphic position of the Lafferty, but because the lithology does not resemble the Lafferty a name is not attached to this part of the sequence. Below this interval, the Silurian rocks were tentatively identified as St. Clair (?) limestone and Brassfield (?) limestone. It is thought that all, or part, of these formations make up the subsurface "Hunton" limestone of northeastern Oklahoma.

The St. Clair (?) limestone is separated from the overlying limestone by a thin zone of pale-purple chert which may mark the unconformable contact of the beds. The St. Clair (?), 165 feet thick, consists of gray to pink, slightly dolomitic limestone. The contact of the St. Clair and the underlying Brassfield is unconformable where exposed on the surface, but this relation could not be recognized in the cuttings.

The lowest Silurian formation identified in the well is the Brassfield (?) limestone, which is 45 feet thick. This formation is similar to the St. Clair (?) in appearance, but may be differentiated by color and crystallinity. The Brassfield (?) has an orange-red color in contrast to the pink color of the St. Clair (?), and is more coarsely crystalline. The Brassfield rests unconformably on the Cason shale where exposed on the surface.

## *Ordovician System*

The Cason shale consists of a gray and green dolomitic shale bed, 42 feet thick, which lies unconformably on the Fernvale limestone. Phosphatic nodules, common in outcrops of the Cason, were not present in the cuttings.

The Fernvale limestone, 29 feet thick, is composed of gray, medium crystalline limestone. The Fernvale in the well did not contain pink calcite crystals as it does in most Fernvale surface exposures of the Ozark region. The Fernvale limestone rests unconformably on the Kimmswick limestone although this fact cannot be determined from the cuttings.

The Kimmswick (?) limestone, 41 feet thick, consists of gray finely crystalline limestone, which is silty near the base, and some dark-colored dense chert. The contact of the Kimmswick with the underlying Plattin is unconformable where seen on the surface.

The Plattin limestone, 30 feet thick, is composed of gray and dark-gray dense limestone. The Plattin rests unconformably on the St. Peter sandstone, as the Joachim dolomite, which normally overlies the St. Peter, appears to be missing.

The St. Peter sandstone, 100 feet thick is composed of the typical rounded frosted sand grains usually associated with the St. Peter sandstone. The formation, as present in the well, is so tightly cemented by gray silty dolomite that some of the samples contain mostly broken sand grains. The formation did not carry enough water for cable-tool drilling, and little evidence of porosity was seen in the cuttings. The St. Peter overlies the Everton formation unconformably where the contact is exposed on the surface.

The Everton formation consists of shale, sandstone, and dolomite. The top of the Everton is marked by a 17-foot bed of gray-green shale, underlain by a 34-foot sandstone bed, which closely resembles the St. Peter. This sandstone may correspond to McKnight's[5] Newton sandstone member of the Everton formation. Below the sandstone, there is a sequence of Everton rocks, 173 feet thick, consisting of dolomite and sandy dolomite with occasional thin beds of sandstone and dark shale. Black shale and dark-gray silty dolomite make up the lowest 16 feet of the well. These rocks closely resemble the Powell dolomite, but may belong to the Everton formation. Due to the lack of conclusive evidence, it is here included in the Everton formation. Drilling was stopped 240 feet below the top of the Everton.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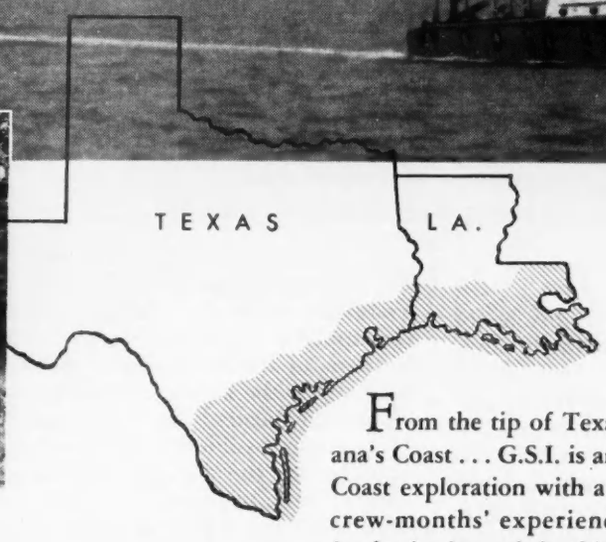


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# Pre-Pennsylvanian Rocks Along The Front Range of Colorado

By JOHN C. MAHER
U. S. Geological Survey, Tulsa

IN connection with regional subsurface investigations by the U.S. Geological Survey in southwestern Kansas, southeastern Colorado, and the Oklahoma Panhandle, 12 detailed sections of pre-Pennsylvanian rocks exposed along the Front Range in Colorado were measured, sampled, and correlated with the formations penetrated by deep wells in eastern Colorado and western Kansas as shown in Table 1. The locations of these sections are indicated in Figure 1 by letters A to J. Reference is made to these locations by letter in the following text.

**THIS ARTICLE constitutes an important additional to the literature of the Rocky Mountain region. It further develops the regional picture necessary for intelligent decisions on where to look for local structure with seismograph and other exploratory methods. Correlation of Mississippian outcrops with similar rocks penetrated in deep tests in eastern Colorado and western Kansas reveals that there exist possibilities for developing production in Mississippian formations along the Front Range. Heretofore the Mississippian was considered to have been erroded before reaching the Front Range. With this additional knowledge operators may now drill for productive stratigraphic traps along the Front Range and the Sierra Grande uplift.**

### Pre-Cambrian Rocks

The igneous and metamorphic rocks that underlie the Paleozoic sedimentary rocks along the Front Range consist principally of granite, gneissic granite, gneiss, schist, and quartzite.

### Upper Cambrian and Lower Ordovician Rocks

*Sawatch Sandstone (Upper Cambrian):*

The basal Paleozoic sandstone of the Front Range, the Sawatch sandstone, crops out on the east side of the Front Range at Manitou Springs, Manitou Park, Perry Park, and at several isolated localities between Colorado Springs and Palmer Lake. The thickness of the Sawatch sandstone ranges from 51 feet in Williams Canyon (H) to 87 feet in Gove Canyon (J). The Sawatch can be readily correlated with the Lamotte sandstone in the subsurface of eastern Colorado and western Kansas.

*Ute Pass Dolomite (Upper Cambrian?) and Manitou limestone, Restricted (Lower Ordovician):*

The Manitou limestone at its type locality in Williams Canyon (H) consists of an upper sequence of alternating limestone and dolomite beds, 187 feet thick, and a lower unit of red very glauconitic, partly sandy coarsely crystalline dolomite, 14 feet thick. The upper unit is fossiliferous and on the basis of fossils has been assigned definitely to the Lower Ordovician by Cloud and Barnes.[1] The lower unit is relatively unfossiliferous and has been included in the Lower Ordovician without definite fossil evidence. This lower dolomite, which appears to rest with a gradational contact on the Sawatch sandstone (Upper Cambrian), is identical lithologically with Bonneterre dolomite of Upper Cambrian age, which lies conformably on the Lamotte sandstone (Upper Cambrian) in the subsurface of eastern Colorado and western Kansas. In the absence of fossil evidence to the contrary, this lower unit is considered by the writer to be Upper Cambrian (?) in age and therefore is excluded from the Manitou in this report. It is termed herein the Ute Pass dolomite for outcrops in the Ute Pass area, which includes the type locality in Williams Canyon. The Ute Pass dolomite exposures range in thickness from feet in Gove Canyon (J) to 16 feet in Missouri Gulch (I).

The Manitou limestone, restricted, crops out almost continuously along the north side of the Canon City embayment and is well exposed in isolated patches near Manitou Springs and Manitou Park. It is absent south of Canon City owing to onlap southward. Its exposures range in thickness from 5 feet in Priest Canyon (D) to 187 feet in Williams Canyon (H).

An important unconformity separates the Manitou limestone, restricted, from the overlying beds. In the Colorado Springs area, it is disconformably overlain by the Williams Canyon limestone; in the Canon City embayment, it is disconformably overlain by the Harding sandstone. The Manitou limestone, restricted, is correlated with the Arbuckle group in the subsurface of eastern Colorado and western Kansas.

### Middle and Upper Ordovician Rocks

*Harding Sandstone*

The Harding sandstone is exposed fairly continuously along the north side of the Canon City embayment. Between Canon City and Beulah, only isolated erosional remnants are present. Thicknesses ranging from 144 feet in Harding quarry (D) to 68 feet in Deadmans Canyon (G) were measured in this investigation.

The Harding sandstone disconformably overlies the Manitou limestone, restricted along the north side of Canon City embayment and overlaps it near Canon City, resting directly upon rocks of pre-Cambrian are in Harding quarry. It is unconformably overlain by the Fremont limestone. The Harding is generally correlated with a part of the Simpson group of Oklahoma.

*Fremont Limestone*

The Fremont limestone crops out with only small gaps along the north

side of the Canon City embayment. It is thickest—281 feet—in Priest Canyon (D) near the center of the Canon City embayment. Unconformities are present both above and below the Fremont limestone. The Fremont limestone correlates with the Viola limestone of the subsurface in western Kansas.

### Mississippian Rocks

The sequence of dolomite and limestone beds overlying the Ordovician rocks and underlying the Pennsylvanian beds along the Front Range has been divided in earlier reports into the Williams Canyon limestone of Devonian age and the Madison limestone of lower Mississippian age.[2] In this report these beds are regarded as middle (?) Mississippian (Meramec) in age and the upper beds previously considered to be the Madison limestone are subdivided herein into the Hardscrabble (lower) and Beulah (upper) limestones.

**TABLE 1**

**Past and present classification of Pre-Pennsylvanian rocks along the Front Range of Colorado, and correlation with subsurface formations in western Kansas.**

| Previous Classification[1] | | Present Classification | | Subsurface Classification in Eastern Colorado and Western Kansas | |
|---|---|---|---|---|---|
| MIDDLE MISSISSIPPIAN | | MIDDLE (?) MISSISSIPPIAN | Beulah limestone | MIDDLE MISSISSIPPIAN | Ste. Genevieve limestone |
| | | | Hardscrabble limestone | | St. Louis limestone |
| | | | Williams Canyon limestone | | Spergen limestone |
| LOWER MISSISSIPPIAN | Madison (or Leadville [2]) limestone | LOWER MISSISSIPPIAN | | LOWER MISSISSIPPIAN | Warsaw limestone<br>Osage group<br>Kinderhook group |
| DEVONIAN | Williams Canyon limestone | DEVONIAN | | DEVONIAN | |
| ORDOVICIAN | Fremont limestone | ORDOVICIAN | Fremont limestone | ORDOVICIAN | Viola limestone |
| | Harding sandstone | | Harding sandstone | | Simpson group |
| | Manitou limestone | | Manitou limestone (restricted) | | Arbuckle group[3] |
| CAMBRIAN | | UPPER CAMBRIAN (?) | Ute Pass dolomite | UPPER CAMBRIAN | Bonneterre dolomite |
| | Sawatch sandstone | UPPER CAMBRIAN | Sawatch quartzite | | Lamotte sandstone |

[1] Brainerd, A. E., Baldwin, H. L., Jr., and Keyte, I. A., pre-Pennsylvanian stratigraphy of Front Range in Colorado: Am. Assoc. Petroleum Geologists Bull., vol. 17, no 4, pp. 375-396, 1933.

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[3] Includes some Upper Cambrian in the type area.

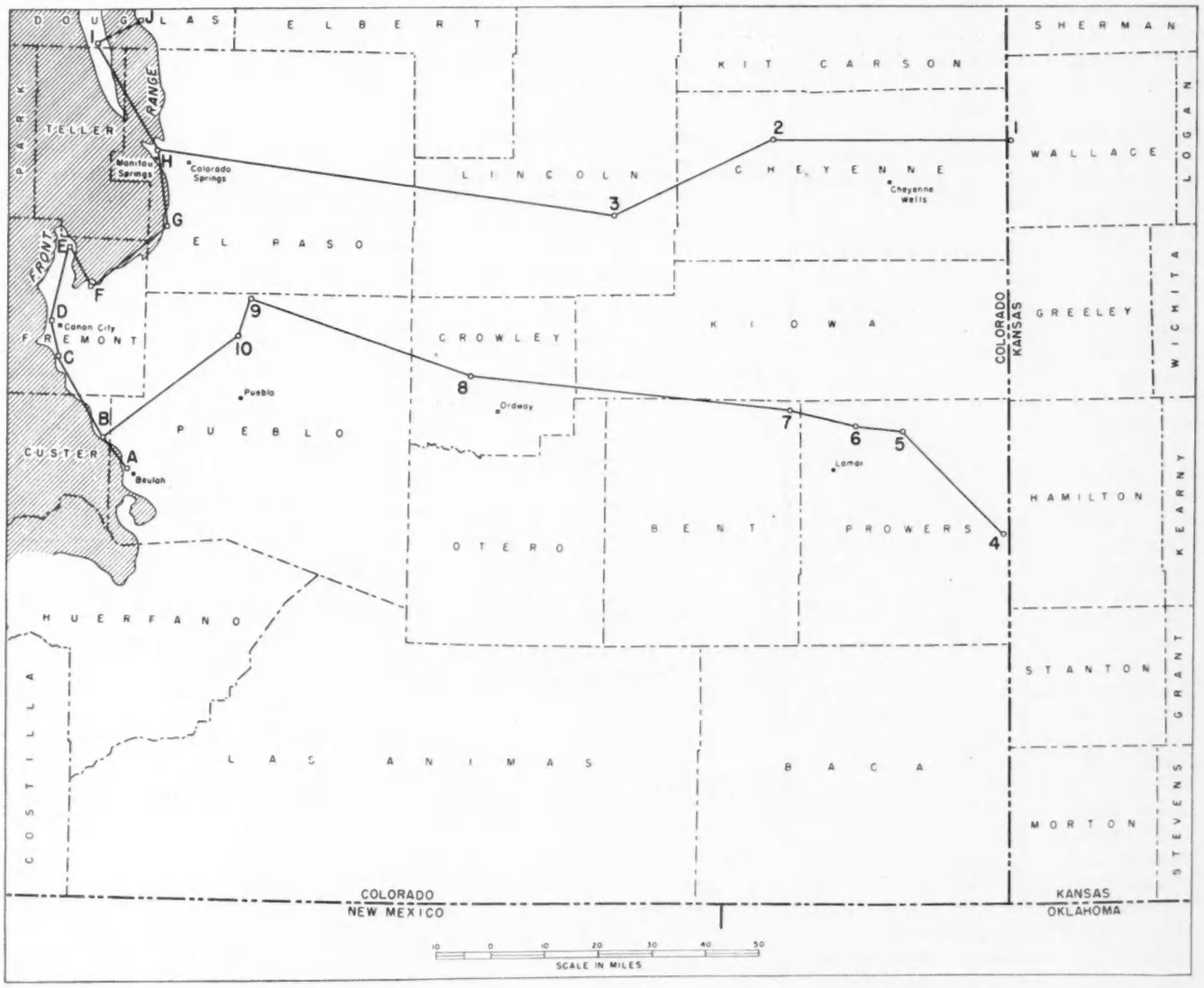


**FIGURE 1. Map of eastern Colorado and western Kansas, showing location of cross-sections.**

*Williams Canyon Limestone*

The Williams Canyon limestone is present and readily recognized in most of the sections measured. A minimum thickness of 16 feet was measured at Beulah (A) and a maximum thickness of 44 feet in Gove Canyon (J). Unconformities at the top and bottom of the Williams Canyon limestone are indicated by the obviously irregular contacts and by the presence in many places of conglomeratic material immediately above these irregularities.

The Williams Canyon limestone has been considered, without fossil evidence, as the equivalent of the Parting quartzite of central Colorado and therefore Devonian in age.[3] Recently Cloud and Barnes,[3] also without fossil evidence, suggested the correlation of the Williams Canyon limestone in the section at Williams Canyon with the Harding sandstone exposed farther south. This latter correlation clearly is not acceptable, as the measured sections at the Oil Creek (E), Priest Canyon (D), South Hardscrabble Creek (B), and Beulah (A) localities show the Williams Canyon limestone lying above not only the Harding sandstone but the Fremont limestone as well.

In the absence of fossil evidence on the outcrops, the approach to this correlation problem seems to be in the subsurface of eastern Colorado. Cross-sections from western Kansas to the Front Range (Figures 2 and 3) reveal the gradual westward overlap of Ordovician rocks by the Mississippian beds, with thinning of the Mississippian due to loss of beds at the base. In Lincoln, Cheyenne, and Kiowa counties, the Mississippian is represented by the Kinderhook, Osage, and Meramec groups; in Crowley County, by the Osage and Meramec groups; and in Pueblo County, by only the Meramec group. Similar conditions on the east flank of the Cierra Grande uplift in the Oklahoma Panhandle have been pointed out by Maher and Collins.[4]

Lithologically, the Williams Canyon limestone is similar to the Spergen limestone, in which the microfossil *Endothyra (baileyii?)* has been found in some wells in eastern Colorado. Stratigraphically, it underlies the Hardscrabble limestone, which is identical with the St. Louis limestone in the wells. In view of these lithologic similarities and supporting stratigraphic relations, the absence of Devonian strata in the subsurface of eastern Colorado and far western Kansas,[4] and the impossibility of correlating the Williams Canyon and Harding formations, it is suggested in this report that the Williams Canyon limestone is middle (?) Mississippian (Meramec) in age.

*Hardscrabble Limestone*

The lower part of the beds previously called Madison limestone along the Front Range form a lithologic unit bounded by two unconformities. This unit is named Hardscrabble limestone for an almost vertical exposure, 124 feet thick, on a thrust block southwest of Wetmore on South Hardscrabble Creek (B), in S½ 11-22S-69W, Custer County, Colorado. The most continuous exposures, which have a maximum thickness of about 125 feet, are in the cliffs along Middle Creek north and west of Beulah. The Hardscrabble limestone is absent in the vicinity of Canon City but the lower part is well exposed in Williams Canyon (H) and in Missouri Gulch (I). Unconformable relations above and below the Hardscrabble limestone are indicated by irregular contacts at most places and by conglomeratic material at some.

The Hardscrabble limestone is correlated in this report with the St. Louis limestone in the subsurface of eastern Colorado and western Kansas. This correlation is based on similarities of thickness, sequence, lithology, and relation to overlying and underlying formations. Fossils collected from the Hardscrabble limestone at

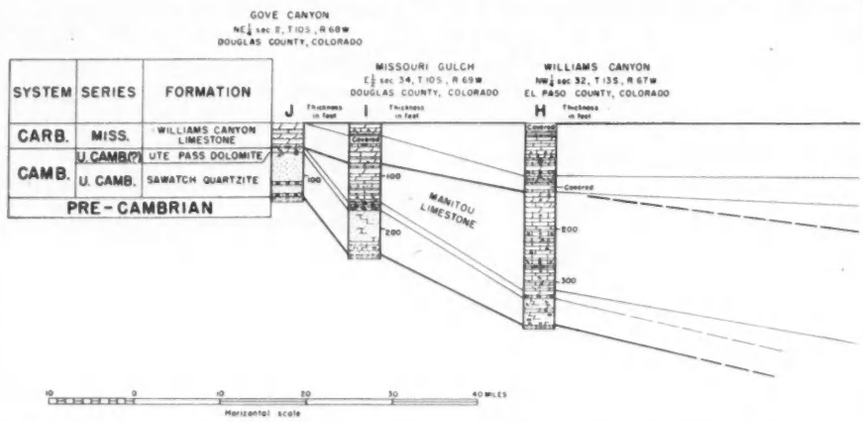


**FIGURE 2. Cross-section of Pre-Pennsylvanian rocks from Well 1 in Wallace County, Kansas, to Section J in Douglas County, Colorado.**

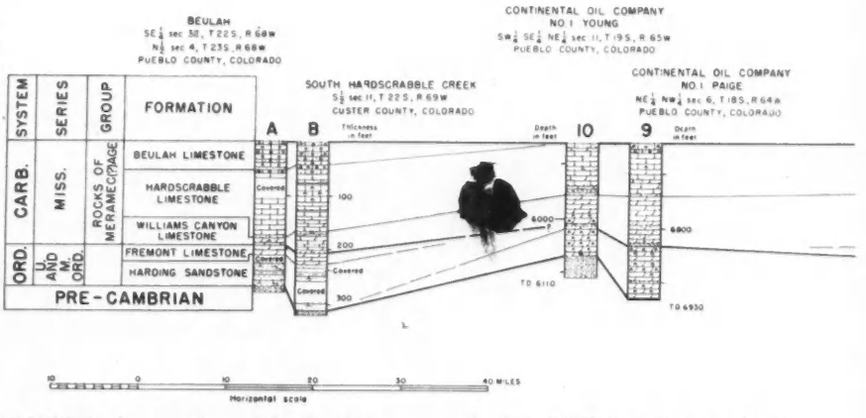


**FIGURE 3. Cross-section of Pre-Pennsylvanian rocks from Well 4 in Prowers County to Section A in Pueblo County, Colorado.**

Beulah were indicative of Mississippian age, according to J. S. Williams[5] of the U. S. Geological Survey, but they are not confined to any one part of the Mississippian.

*Beulah Limestone*

The upper finely sandy and finely oolitic limestone beds of the sequence previously called Madison in the vicinity of Beulah are considered a formation in this report and are named the Beulah limestone for these exposures. The type section is located in NW¼ 4-23S-68W, Pueblo County, Colorado.

As far as the writer knows, the Beulah limestone is restricted to an isolated exposure on South Hardscrabble Creek (B) in Custer County and to the almost continuous upper ledge of the cliffs north and west of Beulah (A) in Pueblo County. Thicknesses of 40 feet and 53 feet were measured on South Hardscrabble Creek (B) and near (A). Unconformable relations exist above and below the Beulah limestone.

The Beulah limestone is correlated with the Ste. Genevieve limestone in wells in eastern Colorado and western Kansas. No fossils were found to substantiate or deny this correlation, but the lithologic characteristics of the two formations are nearly identical and the stratigraphic position is the same. The combination of fine oolites and fine sand in limestone has not been noted in any other formations in either the surface or subsurface in eastern Colorado and western Kansas.


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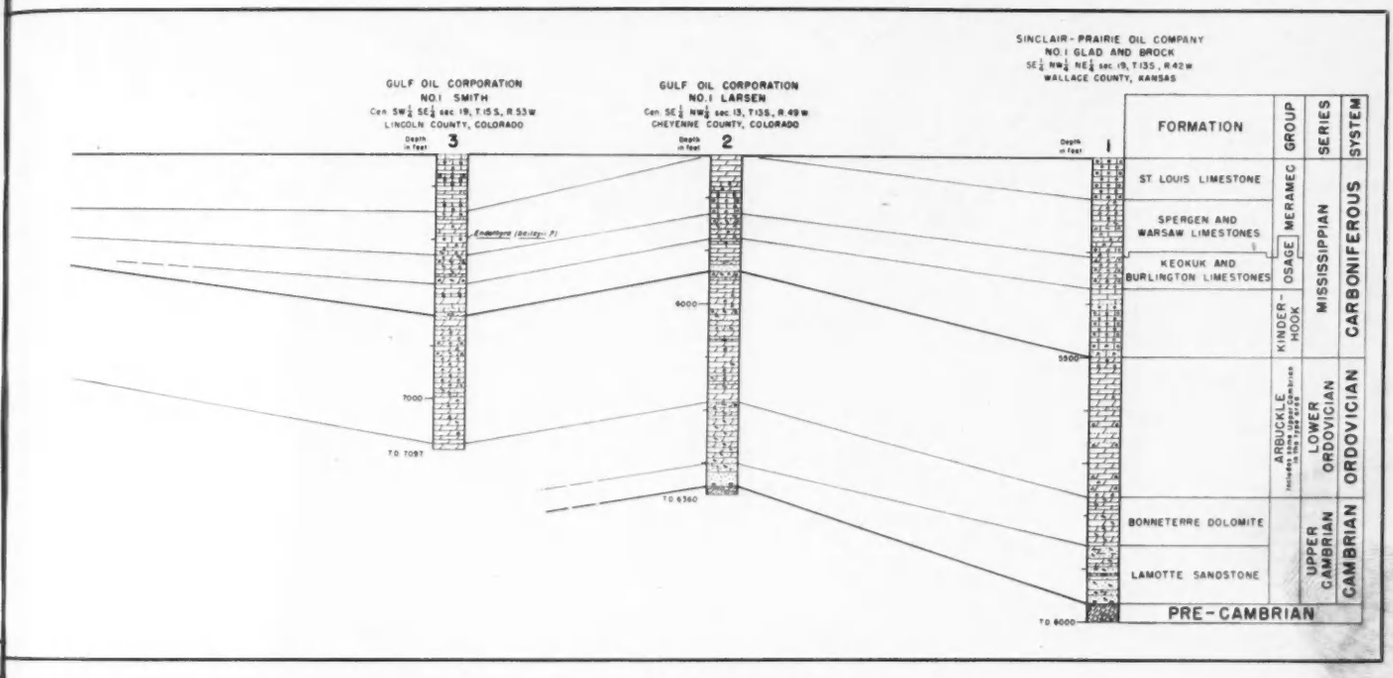


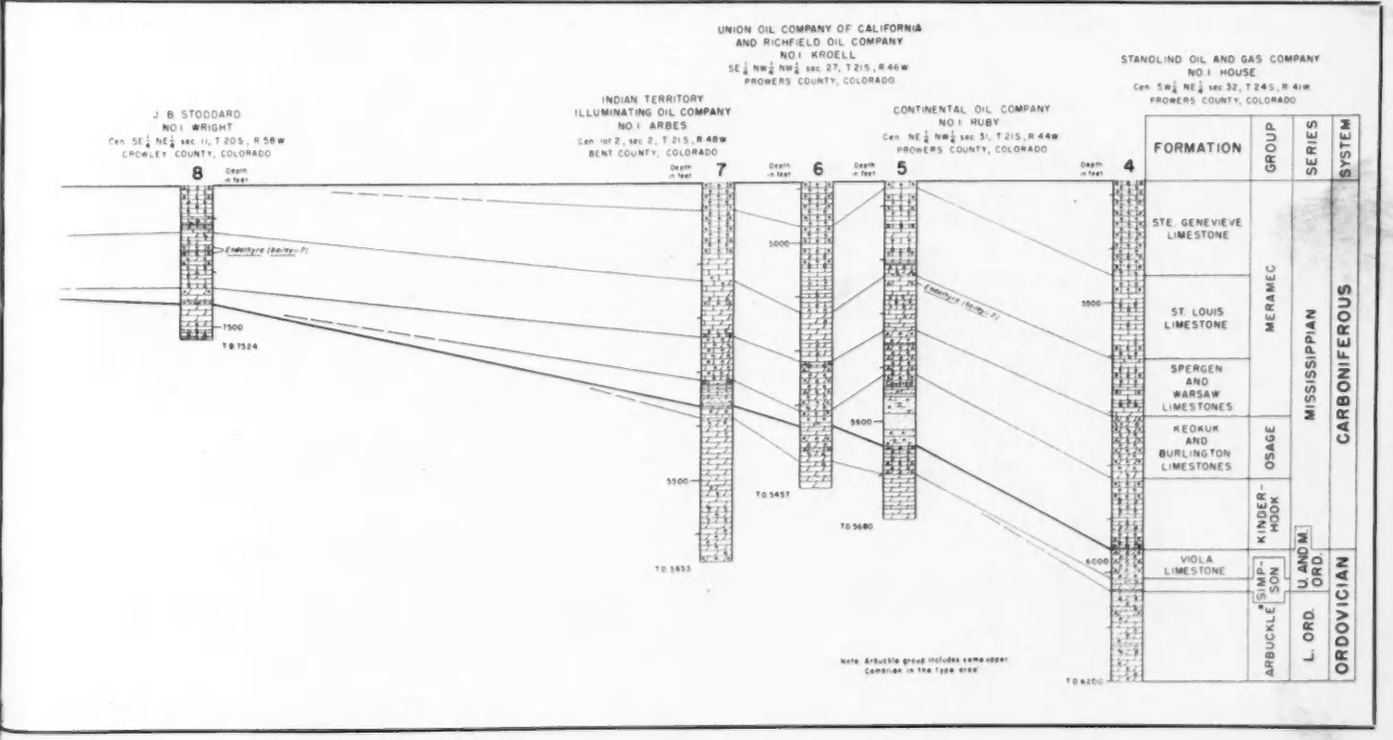

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# Oil Is HOW You Find It

## *Part 1*

By DR. ROBERT W. WHEELER
Wheeler & Ingraham, Dallas

LIKE the practice of medicine, the art of oil finding varies from one individual to another and, like trade secrets derived from varying backgrounds of instruction and personal experience, these techniques remain essentially unformulated for general consumption. Also like the history of the practice of medicine, which evolved from a disreputable past of alchemy, metaphysics and witch doctors, similarly the oil industry is progressing from an unsavory record of charlatans, doodle-buggers, dishonest promotion and non-technical oil ventures to a stage where the industry is more and more impressed by the record of success based upon geological analyses of discovery probabilities.

Exploratory statistics in recent years show that about one out of eight wildcat wells drilled upon various kinds of technical advice were successful, whereas about one out of 30-odd produced without technical advice. The best record of success is clearly held by the cooperative efforts of geologists and geophysicists who together have succeeded in the last few years in one out of every four to six ventures, depending a good deal upon the quality of geophysical and geological interpretation. Since many of the undiscovered oil and gas traps will be stratigraphic rather than structural, they cannot be delineated by geophysical work. They will be approached through inadequate evidence by geologists. Hence, the discovery record of geologists will probably never equal the more refined (but limited) mapping of the geophysicist.

Generally speaking, discovery rate is a measure of the quality of geological investigation which analyzes not only the prerequisites for oil accumulation in each drilling prospect, but also anticipates the economics of drilling costs and ultimate recoveries.

In the evaluation of any undrilled prospect, the basic requirements consist of a trap to localize accumulation and a reservoir objective within a geologic belt or province where the objective is known to carry oil or gas. The simplicity of these prerequisites is most misleading; they are rarely ascertainable in advance of exploratory drilling. Instead, a vast multitude of geologic inferences provide only an estimate of the likelihood that (1) suitably thick and porous rocks are present; (2) within an area where these rocks should be petroliferous; (3) a structural or wedgeout trap is indicated. In other words, there are inevitably many unknowable factors in predetermining these basic requirements.

The most critical of the factors by which the quality of the trap and the oil objectives can be inferred are tabulated in Figure 1. This chart attempts to differentiate between those that predetermine a favorable prospect and those that indicate a questionable or doubtful or unlikely prospect.

*Trap.* Experience indicates that the most important factor to be determined is the existence of a trap for oil or gas accumulation. These fall into two general categories, (1) structural and (2) wedgeout (due either to stratigraphic convergence or to lensing porosity).

*Closure.* This is the essential ingredient of a structural trap. The concept of closure varies a good deal with individual geologists and even more so with non-technical espousers of the quality of a prospect. Actually, closure is a quantitative attribute both as to vertical relief and area. In an anticlinal trap it is a measure of the amount of reversal of dip in opposition to the regional tilt measured between the highest point (saddle) of the adjoining syncline(s) and the crest of the dome. Thus, in a region of prevailing westward tilt, it is by no means sufficient to have ascertained north dip, west dip and south dip, for the *critical dip* must be to the east, and the amount of closure consists of (1) the relief measured in feet between the top of the dome and the adjoining saddle to the east and (2) the area (measured, for example, in acres) that is enclosed by a structural contour passing through the highest point in the adjoining syncline.

In the case of a fault trap, one, for example, in which the fault is presumed to block up-dip migration, closure is a measure of the vertical relief of a domed-up feature from its crest to the highest point in the synclines cut by the fault plane. Since it is common that such a dome is asymmetric, there may be a great difference in the amount of dip in each direction along the fault plane, but the closure is measured in the direction of the *least* dip.

It is difficult to measure closure accurately in advance of the drilling and development of an anticlinal or fault trap. In general, the greatest accuracy is provided by reflection seis-

**THIS ARTICLE is composed of two parts: the first deals with the geological factors that permit an analysis of the probabilities that a prospect will produce and the profitabilities that may be anticipated; the second part concerns the professional responsibilities, limitations and opportunities of the petroleum geologist. The thesis is advanced here that oil geologists will enhance the status of the profession and their own peace of mind by analyzing the prerequisites for profitable oil ventures.**

mograph mapping and yet the sources of possible error are very numerous. For example, the quality of the seismic records are subject to differences of equipment, to the character of the terrane, to all sorts of surficial hindrances, weathering problems, depth of shot hole, powder charge and a jealously guarded array of differences of shooting techniques and interpretation. Velocity assumptions may make or break a prospect such as a thick limestone reef body of low topographic relief that may be interpreted as a structural feature located at depth. The direction of the traverse across a prospect may easily fail to indicate the amount of closure.

Quite often the most reliable reflecting horizon is not the reservoir objective as in north central Oklahoma where the mid-Ordovician, Viola limestone, is the ideal seismic datum but, beneath which the main oil objectives, the Wilcox sands thicken and thin in interval with respect to the overlying Viola. The relief of Viola-Wilcox convergence is sufficient to make or break a structural prospect. Simply stated, structural mapping on a datum that is separated unconformably from the oil objective is *per se* an unreliable picture. Another more complex case in point is that of the Cambro-Ordovician, Arbuckle, of the Central Kansas Uplift whose karst topography, although mappable by refined seismic interpretation, is not a structural map at all. It shows instead the topographic relief of hills, channels and sink holes. If the topographic remnants are high enough above the oil-water contact of contiguous producing areas, the topographic high is likely to produce. However, if a locally productive porous zone of Arbuckle dolomite happens to be removed on a topographic feature, it is fatal.

Even if the reservoir objectives are conformable with the seismic mapping datum and even if closure is rather precisely defined as to vertical relief and areal distribution through faultless interpretation of perfect records, still another factor must be analyzed: What proportion of the closure will be occupied by oil and gas and what part with water? Structural traps whose total closure is saturated with oil or gas are rare. There are areas in which large portions of the closure are occupied by water. The discrepancies between the proportion of petroleum and water saturation seem more pronounced in areas that have suffered two or more different directions of regional tilting. The assumption in such cases is that present closure may not reflect the structural conditions at the time of oil accumulation. In other cases, the explanation is advanced that the hydrocarbons may have been partly flushed by natural water flooding. In still other cases, where the closed dome may be nearly or completely barren of oil, we may be dealing with a reservoir objective whose oil accumulated farther shoreward prior to the structural movements that created the closure, as will be discussed under Reservoir Objectives.

Finally, never overlook the importance of depletion; for example, in an area adjoining older production in which all of the requirements of structural closure and quality of reservoir rocks are ascertainable, but in which permeabilities were sufficient to permit withdrawal of oil over the years of nearby production history.

*Fault Traps.* In the case of fault traps, sad experience indicates that all faults are not seals to migration, but not uncommonly provide a thoroughfare for the migration of oil and gas into a contiguous fault block. In other words, where porous reservoir rocks of different age become juxtaposed due to displacement along a fault plane, oil and gas, depending upon their mobility and the permeability of the rock, may migrate across the fault plane. This is evidently the case in certain producing areas in the Golden Trend of southern Oklahoma where alternating sands of the Ordovician, Simpson series, may test high gravity oil, gas-distillate, or salt water in the same well-bore, whereas these very reservoir rocks may have an entirely different content in a contiguous fault block. The province is highly fractured, mostly by intersecting high angle normal faults, and these, rather than anticlinal folds, constitute the traps for prepennsylvanian oil. Since the amount of vertical displacement varies considerably along the fault trace, the problem of ascertaining in advance of drilling whether or not a specific objective is juxtaposed against a porous formation in a contiguous fault block presents a formidable problem in descriptive geometry, not to mention seismic accuracy. Evidently the operators rely upon the quantity of Simpson sand objectives rather than the provableness of any specific objective in testing an unproven fault block prospect. Although these wells cost as much as $250,000 to drill, exploration and development in this province is rapid. This must indicate that ideal structural traps are no longer abundant.

*Wedgeout Traps.* These are mainly due to the truncation of reservoir rocks or the lapping out of porous rocks across the tilted surface of an unconformity. Both truncation and onlap traps are a function of stratigraphic convergence which in turn is a by-product of regional structural movements; whereas porosity traps, due to facies change, are more a function of sedimentary environment. As such they are more logically treated as variations in the quality of reservoir objectives.

Wedgeout traps are harder to map than structural traps because seismic

**Probabilities of Accumulation**

| | | FAVORABLE | DOUBTFUL |
|---|---|---|---|
| TRAP | Closure | Provable closure with relief in excess of thickness of oil objective; proof of critical dip on flank of anticline opposed to regional tilt; test is located with reference to gas-oil-water levels. Proof that closure is adequate to have retained oil; evidence of a seal to vertical migration. Proof that fault "Trap" is a seal—not a thorofare for up-dip migration. Beware the "bootleg" seismic map, the surface "high" in evaporite terrane, the subsurface prospect contoured on "estimated" datums! | Closure can only be inferred from interruption in Regional dip, or from multiple shows in a high well, or from inadequate seismic control; structural position is uncertain with reference to nearby levels of gas oil and water; reservoir may be depleted by old production, flushed by natural water flooding or drained by early geologic movements; reservoir beds are transitional upward in permeability; fault displacement could juxtapose porous zones allowing through migration of oil and gas; map datum and oil objective are separated by an unconformity. |
| | Wedge-edge | Wedge-edge accurately delineated; test located in a favorable structural position with respect to gas, oil and water levels and pay thickness. Porosity of a wedging reservoir may have been improved by truncation and subaerial leaching or by sorting of an onlapping objective. Effective seal to vertical and up-dip migration. | Direction and rate of convergence uncertain; structural position of test with relation to wedge-edge, pay thickness or fluid content is doubtful. Porosity may be affected adversely by convergence factors, cementation or diagenesis; transitional vertical permeability may indicate unfavorable connate water saturation and poorly sealed reservoir rocks. |
| OBJECTIVE | | Proof of a thick porous reservoir objective which is consistently developed, and the prospect lies within the producing trend of this specific reservoir. | Variations in porosity and pay thickness approach the minimum economic limits of development; pay may wedge-out across structurally high prospect. |
| ECONOMICS | | Crude and gas price, oil gravity, gas-oil-water saturation, per acre recovery, well spacing, productive reservoir area, allowables, pay-out, depletion. | Acreage bonuses, commissions, royalties, oil payments; exploration expense; drilling, testing, equipping, and producing costs; taxation. |
| | | INCOME | EXPENSE |
| PROFITABILITY | | CONSIDERATIONS | |

R. R. Wheeler—2-51

**FIGURE 1. Probabilities and profitabilities.**

# HERE'S HAWTHORNE'S ASPIRIN FOR A DRILLER'S HEADACHE

Seismograph crews drilling shot holes along the Colorado River, south of Columbus, Texas, ran into what might have been a first class headache, as the photograph above will show.

They ran into soft clay and loose gravel formations 30 to 50 feet thick while drilling 90-foot holes. This means really tough drilling because drag bits can't break up the gravel, and rock bits ball up with the soft clay.

Hawthorne "Blue Demon" Rock Cutter Bits drilled through far faster, and the hole was far cleaner and straighter than normally obtained with other bits. Notice in the picture how much gravel was broken up by the Hawthorne Bits.

**This is another example of how Hawthorne "Blue Demon" Rock Cutter Bits reduce bit costs and allow more production with fewer round trips for bit changes.**

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**ROCK CUTTER BITS**
**REPLACEABLE BLADES**
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work, while indicating convergence, cannot define either the all-essential plane of unconformity or differentiate the rate of truncation from that of onlap without subsurface geological control. Thus, the search for stratigraphic traps is largely a problem of subsurface interpretation. When it is realized that the strike of an unconformity need have no genetic relationship to the strike of the beds it truncates, then it can be appreciated that the areal trend of an onlapping sand body may diverge radically from the strike of underlying paleo-outcrop belts. Moreover, a change of facies, that may completely alter the quality of a truncated reservoir objective, is related to an ancient depositional environment, and need have no genetic relation to the subsequently developed trend of the paleo-outcrop.

In other words, it is difficult to map wedgeout traps accurately. Unless one can rather accurately delineate the wedge-edge, the geologist is gambling upon missing the reservoir rock completely or penetrating too thin an interval to be commercially productive and further, unless he can locate a test with reference to the oil-water contact or with knowledge of structural position along the convergence trap, he is gambling on a questionable outcome.

*Oil Objective.* The geologist who recommends a carefully defined structural trap without attempting to ascertain the quality of specific oil objectives is kidding himself. The ideal objective is a thick, porous, consistently developed reservoir within an areal trend producing from the specific formation, or where there is overwhelming evidence that the sedimentary and structural history of the local area is closely related to the geologic history of a nearby producing oil province.

Obviously, if we are dealing with a blanket sand, that is, one of very widespread and rather consistent thickness such as is more characteristic of the older Paleozoic sediments of the Mid-Continent-West Texas oil province and if, moreover, adequate porosity and thickness are indicated in the vicinity of the prospect, the oil objective has favorable attributes. On the other hand, the multiplicity of oil objectives may compensate for irregularities in distribution and in permeability such that in a series of oil objectives the absence of one may be balanced with the appearance of others that may not even have been anticipated.

If the beds overlying the oil objective are not strictly impervious to vertical migration, but instead tend to be transitional upward (as from a sand to silt phase), the effectiveness of a trap, especially a wedgeout trap, is apt to be impaired. However, leakage of lighter hydrocarbons may leave residual asphalt that develops a highly effective seal to vertical migration, e.g. Maracaibo, Venezuela.

Or, if a clastic objective varies rapidly in thickness and grain size due to environmental factors or to irregular overlap upon an uneven surface, the chances of encountering adequate thickness and porosity are greatly reduced. Truncation, which commonly improves the permeability of reservoir rocks where these have been exposed, leached and the cementing material removed, may at the same time have entirely removed the objective (all too commonly on the crest of an anticlinal prospect). Thus convergence studies are essential.

*Productive Trend.* But of all the prerequisites for oil accumulation, the most overlooked is the evidence bearing upon whether or not the prospect lies within a belt of known or inferable accumulation. How many deep and expensive failures have been drilled within the central portions of sedimentary basins to obectives that have never produced beyond the basin margins and whose oil should have migrated toward contemporaneously existing shorelines millions of years prior to the structural movements that created presently mappable traps? Unless these structural movements have been of such magnitude as to expose the reservoir rocks locally and permit their overlap with new source beds for petroleum or unless local faulting is of such displacement as to have brought into juxtaposition these reservoir rocks and new source beds, how can we expect the oil to be recalled from the structurally higher flanks of the basin into subsequently created domes?*

Where the oil objective, although widely distributed geographically, has great variations in permeability that could be expected to have trapped indigenous oil far from contemporaneously existing shorelines, as in the case of the Cambro-Ordovician, Ellenburger, of North, Central and West Texas, the probabilites of accumulation, in areas of favorable porosity, are better. Or, where indigenous oil is apt to be trapped by variations in the permeability of lensing clastic deposits as typified by many of the Tertiary oil objectives of the Gulf Coast, the probabilities of accumulation are enhanced. Or, where a widely distributed porous objective has been rather consistently overlapped with later source beds, as is the case of the Arbuckle of southern Kansas, this objective should be expected to carry oil where porosity and a trap are demonstrated.

This fascinating problem of the time of accumulation relative to the creation of traps is essential to successful prospecting and this is the reason for the conviction that the prerequisites for oil accumulation must be studied from a genetic viewpoint, that is, with the fullest possible comprehension of the geologic history of the region.

Of the foregoing variables relating to the quality of a trap for oil and specific oil objectives, it is quite impossible to state which one factor is the most important. However, it is safe to state that uncertainties regarding these prerequisites are a direct measure of the improbabilities of accumulation. When all of the ascertainable evidence is weighed for the purpose of judging the likelihood of discovery, then it is necessary to further consider certain general aspects of the economics of a drilling venture.

*Profitability.* It is within the province of the oil geologist, and part of his responsibility in a business enterprise, to consider in his recommendation of a favorable prospect the economics of the cost of discovering and producing oil relative to anticipated income from such production. Without seeking to harass the geologic mind with arithmetic problems of finance, it does not seem unreasonable that management should expect its entrusted advisers of the merits of a prospect to venture also an opinion as to ultimate profit. These considerations vary enormously with the size of an exploratory organization. For a major company, forced to investigate unknown provinces with an eye to distant future reserves, the regional prospect may be considered as underwritten by production from other areas and income from other departments, e.g., marketing. Tax legislation is an equally important consideration in ultimate profitability. On the other hand, the geologist for an independent operator or for small organizations in general must consider with greater refinement the economic merit of a venture. For example, he is interested in the cost of acquiring acreage on a prospect or the commissions paid for the acquisition of a favorable submittal; the size of overriding royalties and oil payments that must be paid out of production in addition to

* The foregoing implies that oil and gas migrate relatively soon after the deposition of reservoir rocks. This is the writer's opinion, but is not shared by all geologists. Thus, it is desirable, in speculating upon the probabilities of accumulation in central basin areas, to consider with imagination every factor that might possibly improve these possibilities such as the development of limestone reefs which commonly are surrounded by less pervious shales and limestones. These may prevent shoreward migration of oil indigenous to the reef locality.

the landowners' one-eighth royalty.

But in any case, it is desirable to consider drilling costs. They are not merely a function of depth; the difficulty of keeping a straight hole in steeply dipping formations, the risk of losing the hole in a section of sloughing shale, and the time and rock bit expense of drilling hard siliceous formations are but a few of the drilling cost considerations. And since these are, strictly speaking, geological factors, it is assuredly up to the geologist to consider them in advance of drilling.

On the income side of the account, there is no one better able than the geologist to advance an opinion as to the probable thickness of pay, its anticipated range of porosity, the likelihood of a high or low connate water content (which is commonly a function of its permeability) and, thereby, come to both an optimistic and a conservative range of opinion as to per acre recovery. Of course, these calculations are "best guesses" based upon experience and upon a comparison with comparable producing sections under similar conditions. Then, in terms of producing depth and applicable spacing and allowable orders, it is possible to estimate roughly per well payout and ultimate productivity. Finally, the areal extent of the prospect is of great importance, for it is obviously much more profitable to develop a large reservoir than it is to invest the same drilling expense in a new series of wildcat ventures.

Fortunately, oil is so valuable that the ratio of profit to drilling and production expense increases more rapidly with per acre recoveries than it is influenced by drilling depth until a limit of diminishing returns must occur where drilling costs become prohibitive in terms of predictable reservoir quality.


**ACKNOWLEDGMENTS**

This paper is intended to be more philosophical than technical. As such, the main sources of ideas derive from discussions with colleagues in the oil business. Instead of assembling a multitude of specialized references, the reader is referred to the following excellent sources for analyses of factors in oil accumulation:

1. *Problems of Petroleum Geology* (Sidney Powers Memorial Volume), Amer. Assoc. Petrol. Geol., 1934, pp. 247-825.
2. *The Migration and Accumulation of Petroleum and Natural Gas,* Quarterly of the Colorado School of Mines, Vol. 40, No. 1, 1945, pp. 5-111 (including bibliography).

The writer wishes to express his appreciation to many friends in the Mid-Continent-West Texas region who have helped tremendously to clarify the ideas expressed here as ever available sounding-boards whose return echoes have been far clearer than the initial voice! Especial thanks are due my partner, Jake N. Ingraham, who is a teacher of values, and to the following who have been kind enough to read and criticize this manuscript: C. W. Tomlinson; Norman C. Smith, Photogeologist; Hubert E. Bale; A. I. Levorsen; and H. V. Tygrett, The Atlantic Refining Company, Dallas. Also, I wish to thank Evelyn Jerome who has patiently typed and retyped three different manuscripts from which this article was condensed.



A fortunate few people we know have struck

Oil at shallow depths such as

several hundred feet.....

And others we know have had to go as

low as 20,000 feet before their

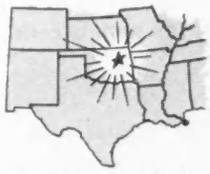
drilling was complete

BUT that's the oil business - there's one

whale of a lot of differentials

Before you wind up with the essentials

AND that's why so many banks throughout



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"farm-out" loans, because Oil always

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and Oil men

even if we do

say so-we are very well versed

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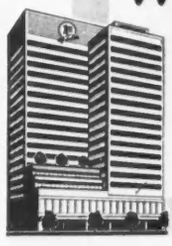

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# Exploration Reaches High Of 1027 Wells in August

AN ALL-TIME high of 1027 exploratory tests were completed in the U. S. during August to top the previous high mark of 997 recorded in June. Even though recent months have seen new exploratory drilling records set, the results have not quite been up to previous standards.

August's drilling resulted in 169 successful wells for a score of 16.5 percent, and the previous month recorded success in 15.8 percent of the wells. Until the end of June, this year's exploration had enjoyed a success ratio of 19.5 percent, which has been about the standard of previous years. But the two succeeding months pulled the score for the year down to 18.5 percent.

A total of 112 new oil pools were opened during August to bring the total for the year to 867, while a year ago the total had been 711. The month's pools were comprised of 87 new oil fields and 25 new pay horizons in previously opened fields.

Gas pools found during the month totaled 20, with a breakdown of 15 new fields and five new pays. Those hiked the year's finds to 139 gas discoveries. Distillate pools opened during the month numbered only six, bringing the year's total to 56, which just topped the 55 discovered in the first eight months of 1950.

**Summary of Results of Exploratory Drilling**

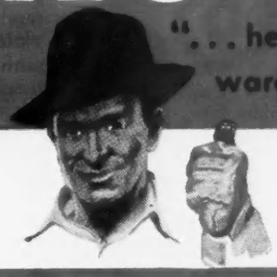
| ITEM | Aug., 1951 | July, 1951 | EIGHT MONTHS January-August 1951 | 1950 | Percent Diff. |
|---|---|---|---|---|---|
| **Oil Discoveries** | 112 | 112 | 867 | 711 | + 21.9 |
| New Fields | 87 | 91 | 641 | 522 | + 22.8 |
| New Pays | 25 | 21 | 226 | 189 | + 19.6 |
| **Distillate Discoveries** | 6 | 6 | 56 | 55 | + 1.8 |
| New Fields | 4 | 3 | 38 | 44 | — 13.6 |
| New Pays | 2 | 3 | 18 | 11 | + 63.6 |
| **Gas Discoveries** | 20 | 18 | 139 | 94 | + 47.9 |
| New Fields | 15 | 17 | 111 | 82 | + 35.4 |
| New Pays | 5 | 1 | 28 | 12 | +133.3 |
| **Total Discoveries** | 138 | 136 | 1,062 | 860 | + 23.5 |
| **Extensions to Fields** | 31 | 19 | 194 | 218 | — 11.0 |
| Oil Fields | 29 | 18 | 153 | 193 | — 20.7 |
| Distillate Fields | 1 | ..... | 12 | 7 | + 71.4 |
| Gas Fields | 1 | 1 | 29 | 18 | + 61.1 |
| **Total Prod. Tests** | 169 | 155 | 1,256 | 1,078 | + 16.5 |
| **Dry Holes** | 858 | 827 | 5,539 | 4,450 | + 24.5 |
| Wildcats | 828 | 793 | 5,273 | 4,294 | + 22.8 |
| New Pays | 1 | 3 | 10 | 6 | + 66.7 |
| Outposts | 29 | 31 | 256 | 150 | + 70.7 |
| **Total Expl'tory Tests** | 1,027 | 982 | 6,795 | 5,528 | + 22.9 |
| Percent Productive | 16.5 | 15.8 | 18.5 | 19.5 | ..... |
| Percent Dry | 83.5 | 84.2 | 81.5 | 80.5 | ..... |

**Results of Exploratory Drilling in August and First 8 Months, 1951-1950, by Districts**

| State or District | MONTH OF AUGUST 1951 | | | | | | | | | | | | | FIRST EIGHT MONTHS, 1951 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Productive Tests | | | | | | | | | | Unproductive Tests | | | | Productive Tests | | | | | | | | | Unproductive Tests | | | Total Dry | | Total Exploratory Tests | |
| | New Fields | | | New Pays | | | Extensions | | | Total Productive | | | | Total Exploratory Tests | New Fields | | | New Pays | | | Extensions | | | 8 Mo. 1951 | 8 Mo. 1950 | | | | | |
| | Oil | Dis. | Gas | Oil | Dis. | Gas | Oil | Dis. | Gas | | Wildcats | New Pays | Outposts | | Oil | Dis. | Gas | Oil | Dis. | Gas | Oil | Dis. | Gas | | | Wildcats | New Pays | Outposts | 8 Mo. 1951 | 8 Mo. 1950 | 8 Mo. 1951 | 8 Mo. 1950 |
| Alabama | | | | | | | | | | | 1 | | | 1 | | | | 1 | | | 2 | | | 3 | 2 | 10 | | | 10 | 13 | 13 | 15 |
| Arizona | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | 2 | 4 | 2 | 4 |
| Arkansas | | | | 1 | | | | | | 1 | 7 | | 2 | 10 | 3 | | 1 | 8 | | | 2 | | | 14 | 9 | 57 | | 6 | 63 | 64 | 77 | 73 |
| California | | | 1 | 3 | | | 2 | | | 6 | 37 | | 3 | 46 | 18 | | 2 | 14 | | | 9 | | 1 | 44 | 36 | 290 | 3 | 28 | 321 | 254 | 365 | 290 |
| Colorado | | | | | | | | | | | 6 | | | 6 | 4 | | 3 | | | 1 | | | | 8 | 3 | 66 | | 2 | 68 | 30 | 76 | 33 |
| Florida | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | 3 | | | 3 | 7 | 3 | 7 |
| Georgia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 4 |
| Idaho | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | 3 | 1 | 3 |
| Illinois | 3 | | | 1 | | | 9 | | | 13 | 78 | | | 91 | 17 | | | 13 | | | 33 | | | 63 | 76 | 462 | | | 462 | 470 | 525 | 546 |
| Indiana | 4 | | | | | | | | | 4 | 43 | | | 47 | 26 | | | 5 | | | 2 | | | 33 | 36 | 229 | | | 229 | 327 | 262 | 363 |
| Kansas | 13 | | 1 | | | | | | | 14 | 76 | | | 90 | 107 | | 7 | 20 | | | | | | 134 | 74 | 533 | | | 533 | 390 | 667 | 464 |
| Kentucky | 1 | | | | | | | | | 1 | 17 | | | 18 | 10 | | | 7 | | | 7 | | | 24 | 12 | 122 | | | 122 | 56 | 146 | 68 |
| Louisiana | 3 | 1 | 1 | 1 | 1 | 2 | | | | 9 | 42 | | 4 | 55 | 24 | 4 | 3 | 15 | 3 | 4 | 10 | 1 | 1 | 65 | 63 | 210 | 1 | 16 | 227 | 136 | 292 | 199 |
| North Louisiana | 3 | | | 1 | | 2 | | | | 6 | 32 | | 2 | 40 | 13 | | | 4 | 1 | 4 | 5 | 1 | 1 | 29 | 19 | 139 | 1 | 6 | 146 | 61 | 175 | 80 |
| South Louisiana | | 1 | 1 | | 1 | | | | | 3 | 10 | | 2 | 15 | 11 | 4 | 3 | 11 | 2 | | 5 | | | 36 | 44 | 71 | | 10 | 81 | 75 | 117 | 119 |
| Maryland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Michigan | | | 1 | | | | | | | 1 | 25 | | | 26 | 7 | | 4 | 1 | | 1 | 1 | | | 14 | 26 | 201 | | | 201 | 184 | 215 | 210 |
| Mississippi | | | | | | | | | | | 20 | | | 20 | 6 | 2 | | 2 | 1 | | | | | 11 | 13 | 88 | | 5 | 93 | 98 | 104 | 111 |
| Missouri | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 3 |
| Montana | | | | | | | 1 | | | 1 | 11 | 1 | 2 | 15 | 1 | | | | | | 4 | | | 5 | 3 | 29 | 1 | 5 | 35 | 37 | 40 | 40 |
| Nebraska | 1 | | | | | | 1 | | | 2 | 9 | | 2 | 13 | 6 | | | 1 | | | 2 | | 4 | 13 | 7 | 40 | | 5 | 45 | 32 | 58 | 39 |
| Nevada | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | 2 | | 2 | |
| New Mexico | 3 | | | | | | | | | 3 | 4 | | | 7 | 11 | | 7 | 4 | | | 2 | | 1 | 25 | 20 | 44 | | 7 | 51 | 55 | 76 | 75 |
| North Dakota | | | | | | | | | | | 2 | | | 2 | 1 | | | | | | 1 | | | 1 | | 5 | | | 5 | | 6 | |
| Ohio | | | | | | | | | | | 1 | | | 1 | | | | | | | 1 | | 4 | 5 | 3 | 16 | | | 16 | 7 | 21 | 10 |
| Oklahoma | 8 | 1 | 1 | 3 | | | 6 | | | 19 | 81 | | | 100 | 48 | 1 | 6 | 17 | 2 | 1 | 23 | 2 | 2 | 102 | 113 | 437 | | | 437 | 325 | 539 | 438 |
| Pennsylvania | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | | | | 1 | | |
| South Dakota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 4 |
| Tennessee | | | | | | | | | | | | | | | | | | | | | | | | | | 6 | | | 6 | 4 | 6 | 4 |
| Texas | 49 | 2 | 10 | 15 | 1 | 3 | 9 | 1 | 1 | 91 | 346 | | 14 | 451 | 343 | 31 | 74 | 110 | 12 | 20 | 49 | 9 | 16 | 664 | 565 | 2335 | 5 | 170 | 2510 | 1862 | 3174 | 2427 |
| Dist. 1 S. Central | 2 | | | | | | 3 | | | 5 | 37 | | | 42 | 16 | | | 4 | 1 | | 4 | | 1 | 26 | 13 | 142 | | 12 | 154 | 132 | 180 | 145 |
| Dist. 2 Middle Gulf | 2 | 1 | | 2 | 1 | 1 | 2 | | 1 | 10 | 24 | | 1 | 37 | 10 | 9 | 11 | 18 | 2 | 9 | 5 | 2 | 4 | 70 | 42 | 137 | 1 | 26 | 164 | 108 | 234 | 150 |
| Dist. 3 Upper Gulf | 4 | | 3 | 2 | | 1 | | | | 10 | 23 | | | 33 | 16 | 8 | 16 | 19 | 2 | 3 | 2 | 1 | 2 | 69 | 73 | 183 | | 4 | 187 | 152 | 256 | 224 |
| Dist. 4 L. Gulf-S.W. | 2 | | 3 | 4 | | 1 | | 1 | | 11 | 32 | | 4 | 47 | 22 | 6 | 16 | 27 | 6 | 6 | 5 | 1 | 6 | 95 | 69 | 236 | 1 | 26 | 263 | 201 | 358 | 270 |
| Dist. 5 E. Central | 1 | | | 2 | | | 2 | | | 5 | 10 | | | 15 | 4 | 2 | | 4 | | | 7 | | | 17 | 4 | 112 | | 2 | 114 | 50 | 131 | 54 |
| Dist. 6 Northeast | 1 | 1 | | | | | | | | 2 | 12 | | 1 | 15 | 6 | 3 | | 1 | | | 1 | 5 | | 16 | 14 | 59 | | 3 | 62 | 55 | 78 | 69 |
| Dist. 7-B N. Cent. | 14 | | 3 | 3 | | | | | | 20 | 97 | | | 117 | 119 | | 17 | 11 | | | 4 | | 2 | 153 | 126 | 629 | | 13 | 642 | 410 | 795 | 536 |
| Dist. 7-C W. Cent. | 7 | | 1 | 1 | | | | | | 9 | 34 | | 1 | 44 | 40 | 1 | 3 | 4 | 2 | | 4 | | | 54 | 34 | 199 | | 5 | 204 | 135 | 258 | 169 |
| Dist. 8 West | 8 | | | | | | 1 | | | 9 | 35 | | | 44 | 42 | | 4 | 12 | | | 9 | | | 67 | 92 | 248 | 3 | 13 | 264 | 192 | 331 | 284 |
| Dist. 9 North | 8 | | | 1 | | | 1 | | | 10 | 37 | | 6 | 53 | 65 | 2 | 1 | 13 | | 2 | 8 | | 1 | 92 | 98 | 375 | | 65 | 440 | 420 | 532 | 518 |
| Dist. 10 Panhandle | | | | | | | | | | | 5 | | 1 | 6 | 3 | | 2 | | | | | | | 5 | 1 | 15 | | 1 | 16 | 7 | 21 | 8 |
| Utah | 1 | | | | | | | | | 1 | 4 | | | 5 | 2 | | | | | | | | | 2 | 1 | 16 | | | 16 | 9 | 18 | 10 |
| Washington | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| West Virginia | | | | | | | | | | | 1 | | | 1 | | | 2 | | | | | | | 2 | | 2 | | | 2 | | 4 | |
| Wyoming | 1 | | | 1 | | | 1 | | | 3 | 16 | | 2 | 21 | 7 | | 1 | 8 | | 1 | 6 | | | 23 | 16 | 67 | | 12 | 79 | 69 | 102 | 85 |
| Total U. S. | 87 | 4 | 15 | 25 | 2 | 5 | 29 | 1 | 1 | 169 | 828 | 1 | 29 | 1027 | 641 | 38 | 111 | 226 | 18 | 28 | 153 | 12 | 29 | 1256 | 1078 | 5273 | 10 | 256 | 5539 | 4450 | 6795 | 5528 |

# and Canada

## STORES



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# U. S. Oil, Distillate and Gas Discoveries and Extensions in August

### ARKANSAS—NEW OIL PAY

**Union County, El Dorado, East field.** Pan Am Southern Corporation's Ezzell 1, in 13-17s-15w, flowed 75 barrels from Cotton Valley sand, Jurassic 5026-28 feet, 39.6-gravity, 5/32-inch, completed 8-29-51, TD 6366.

### CALIFORNIA—NEW OIL PAYS

**Kern County, Edison field.** Golden Bear Oil Company's Seale 1, in 5-30s-29e, pumped 45 barrels from Walker sand, Miocene 3975-4122 feet, 17-gravity, completed 8-10-51, TD 4122.

**Los Angeles County, Castaic Junction field.** Humble Oil & Refining Company's Newhall Corporation 1, in 24-4n-17w, flowed 450 barrels from 10,614-899 feet, 18.2-gravity, ½-inch, completed 8-27-51, TD 10,901.

**Orange County, Huntington Beach, North field.** Charles S. Black's Black Oil 1 (OWDD), in 2-6s-11w, pumped 48 barrels from 2108-26 feet, 19.4-gravity, completed 8-10-51, TD 5400.

### CALIFORNIA—OIL FIELD EXTENSIONS

**Fresno County, Coalinga, East field.** Max Pray & Elisha Walker, Junior's Nidever 2, in 24-20s-15e, west extension, flowed 375 barrels and 500 barrels water from 7836-58 feet, 30-gravity, completed 6-29-51, TD 7860.

**Kern County, Fruitvale field.** New-Cal Associates Oil Company's Fisher & Wosk 1, in 28-29s-27e, ½-mile southwest extension, flowed 67 barrels from Middle Kernco sand, Miocene 4312-4405 feet, 3/16-inch, completed 8-6-51, TD 4405.

### CALIFORNIA—NEW GAS FIELD

**Butte County.** Honolulu Oil Corporation's Honolulu-Humble Wild Goose 1, in 17-17n-1e, flowed 3.5-million from 3292-3314 feet, completed 8-7-51, TD 4009.

### ILLINOIS—NEW OIL FIELDS

**Hamilton County, Broughton field.** Carter Oil Company's J. Van Winkle 1, NE NE SW 27-6s-7e, pumped 92 barrels and 96 barrels water from McClosky lime, Mississippian 3277-82 feet, completed 8-28-51, TD 3330.

**Washington County, Beaucoup field.** Collins Brothers & Obering's William Meinert 1, NW NE SW 10-2s-2w, pumped 50 barrels from Devonian lime, Devonian 3070-76 feet, completed 8-7-51, TD 3080.

**Wayne County, Keenville, East field.** Bolin & Appleby's Clevenger 1, SE NE NE 36-1s-5e, pumped 67 barrels from McClosky lime, Mississippian 3165-69 feet, completed 8-7-51, TD 3172.

### ILLINOIS—NEW OIL PAY

**Effingham County, Mason field.** H. Luttrell's C. J. Moritz 2, NW SE NW 23-6n-5e, pumped 60 barrels from Bethel sand, Mississippian 2296-2304 feet, completed 8-21-51, TD 2304.

### ILLINOIS—OIL FIELD EXTENSIONS

**Clay County, Stanford field.** Ashland Oil & Refining Company & A. G. Becker's O. Lee 1, NE NW SW 26-3n-7e, ¾-mile extension, pumped 60 barrels from McClosky lime, Mississippian 3033-40 feet, completed 8-21-51, TD 3081.

**Edwards County, Bone Gap field.** Gallagher's L. G. Smith1, NW NW SW 18-1s-14w, ¾-mile south extension, pumped 50 barrels from Waltersburg sand, Mississippian 2310-15, completed 8-21-51, TD 3193.

**Wabash County, Mt. Carmel field.** Indiana Farm Bureau's G. H. Zimmerman 1, NW SW 10-1s-12w, ¾-mile east extension, pumped 40 barrels from Cypress sand, Mississippian 1970-79 feet, completed 8-21-51, TD 1933.

**Washington County, Irvington field.** Hockman's Riechman 1, NW SE NW 25-1s-1w, 1-mile east extension, pumped 41 barrels from Barlow lime, Mississippian 1525-28 feet, and Cypress sand, Mississippian 1532-38 feet, completed 8-28-51, TD 1540.

**Wayne County, Goldengate, West field.** N. V. Duncan's Locke 1, SE SE NW 17-2s-9e, ¾-mile extension, pumped 30 barrels from Lower O'Hara lime, Mississippian 3322-29 feet, completed 8-21-51, TD 3459.

Tuley & Carter Drilling Company's Evans 1, SW NW SE 8-2s-9e, ¾-mile extension, pumped 12 barrels and 3 barrels water from Aux Vases sand, Mississippian 3235-49 feet, completed 8-7-51, TD 3252.

**Mitchell field.** George Pappas & Ashland Oil & Refining Company's Allison Heirs 1, NE NE NW 36-2s-9e, ½-mile west extension, pumped 75 barrels and 30 barrels water from McClosky lime, Mississippian 3322-32 feet, completed 8-21-51, TD 3388.

**White County, Bend field.** B. M. Heath & Inland Production Company's J. L. Brown 1, SE NE SE 16-5s-14w, 1¼-mile northeast extension, pumped 250 barrels from Tar Springs sand, Mississippian 2256-76 feet, completed 8-7-51, TD 2276.

**New Haven Consolidated field.** Tuley & Carter's W. L. Wasem 1, NW NE SE 24-7s-10e, ½-mile west extension, pumped 125 barrels and 50 barrels water from Tar Springs sand, Mississippian 2137-55 feet, completed 8-7-51, TD 2157.

### INDIANA—NEW OIL FIELDS

**Gibson County, Tri-County field.** J. L. Black Oil Producers, Incorporated's Tressie H. Pool 1, in 8-3s-8w, estimated 10 barrels from McClosky lime, Mississippian, TD 1719.

**Unnamed field.** A. W. & Blair Cherry's Anton Lutz 1, NW NW SW 13-4s-11w, pumped 186 barrels from Aux Vases sand, Mississippian 2288-97 feet, TD 2297.

**Knox County.** S. D. Jarvis & Lohmann-Johnson Drilling Company, Incorporated's Amel Helderman 1, in 21-2n-8w, pumped 50 barrels from Aux Vases sand, Mississippian 1314-23 feet, TD 1323.

**Monroe County.** George Pappas et al's Robert W. Smith 1, SE SE SW 21-7n-1e, pumped 8 barrels and 50 barrels water from Trenton lime, Mississippian 1766-80 feet, TD 1795.

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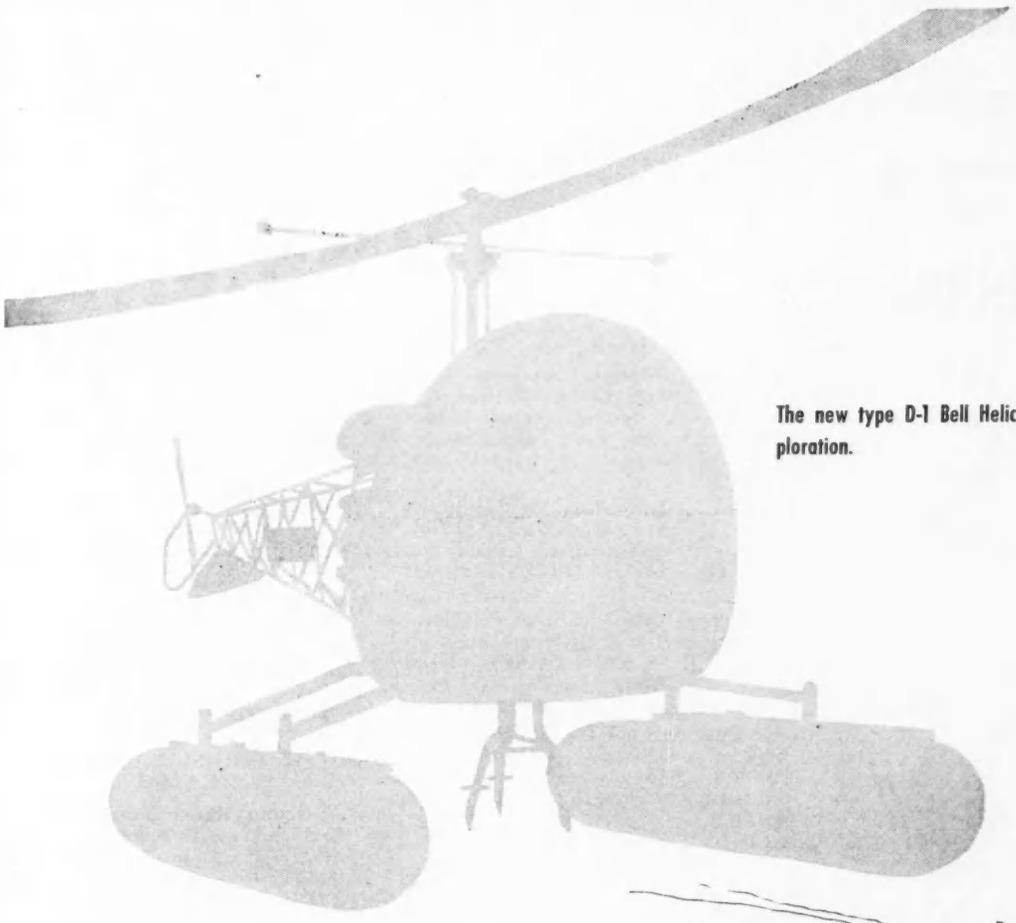

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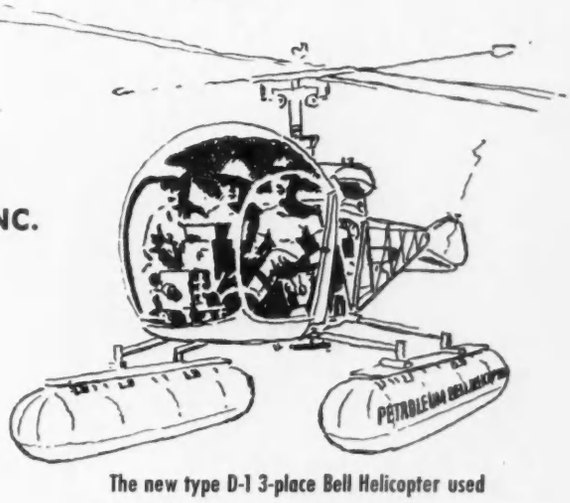

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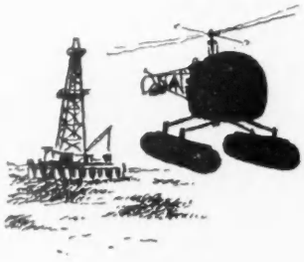

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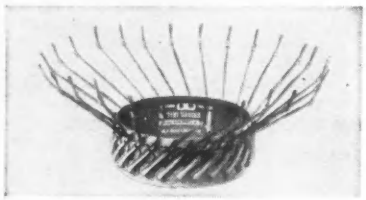

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### KANSAS—NEW OIL FIELDS

**Barton County, Werne field.** W. J. Coppinger's Werne 1, NW SW NE 4-20s-12w, pumped 182 barrels from Arbuckle lime, Ordovician 3384-3402 feet, TD 3402.

**Ellis County, Pleasant Ridge, Southwest field.** Isern Drilling Company's Krannawitter 1, SE SW NW 19-12s-17w, pumped 129 barrels from Arbuckle lime, Ordovician 3672-88 feet, TD 3688.

**Graham County, Crocker field.** Jones, Shelburne & Farmer's Teall 1, SE SE NW 18-10s-21w, pumped 232 barrels from Arbuckle lime, Ordovician 3914-21 feet, TD 3923.

**Phillips County.** Lewis Drilling Company's Kelly 1, NE NE SE 23-2s-19w, pumped 163 barrels from Lansing-KC lime, Pennsylvanian 3458-62 feet, TD 3568.

**Reno County, Morton, Southeast field.** Cities Service Oil Company's Birket 1, SW SW SW 16-24s-8w, pumped 39 barrels and 2 barrels water from Lansing-KC lime, Pennsylvanian 3423-35 feet, TD 3785.

**Sankey field.** Atlantic Refining Company's Sankey 1, NW NW NW 22-22s-10w, pumped 502 barrels from Lansing-KC lime, Pennsylvanian 3187-95 feet, TD 3669.

**Rooks County, Riffe field.** Sohio Petroleum Company & B & R Drilling Company's Riffe 1, SE SE SW 4-7s-19w, pumped 119 barrels from Lansing-KC lime, Pennsylvanian 3275-3307 feet, TD 3551.

**Russell County, Coal Creek field.** Alpine Oil & Gas Company's Daniels 1, NW NW SW 22-15s-11w, pumped 25 barrels from Conglomerate 3178-88 feet, TD 3188.

**Saline County, Bachofer field.** A. L. Harper's Bachofer 2, C S½ NE NE 15-15s-2w, pumped 20 barrels from Mississippi lime, Mississippian 2799-2805 feet, TD 2805.

**Holm field.** Bay Petroleum Corporation & Musgrove Petroleum Corporation's Holm 1, NW NW NW 32-16s-3w, pumped 207 barrels from Maquoketa shale, Ordovician 3406-12 feet, TD 3639.

**Stafford County, Mueller, Northwest field.** Murfin Drilling Company's Batman 1, SE SW SE 12-21s-13w, pumped 290 barrels from Arbuckle lime, Ordovician 3522-31 feet, TD 3531.

**Smallwood field.** Westgate-Greenland Oil Company's Wetig 1, NW NW SE 2-22s-14w, flowed 676 barrels from Lansing-KC lime, Pennsylvanian 3477-3543 feet, 32-gravity, TD 3813.

**Sumner County, Guelph field.** Herndon Drilling Company's Gurley 1, NE SW NE 6-35s-1e, pumped 87 barrels from Layton sand, Pennsylvanian 3026-73 feet, TD 3073.

### KANSAS—NEW GAS FIELD

**Barber County.** Skelly Oil Company's Harbaugh C-1, SE SW SE 13-33s-12w, flowed 5.6-million from Douglas sand, Pennsylvanian 3659-68 feet, TD 5058.

### KENTUCKY—NEW OIL FIELD

**Daviess County.** Stanley Drilling Company's Stanley Greer 1, SE SW SE 20-0-32, pumped 2 barrels and 10 barrels water from Cypress sand, Mississippian 791-808 feet, TD 808.

### NORTH LOUISIANA—NEW OIL FIELDS

**LaSalle Parish, Catahoula Lake, North field.** Carter Oil Company's State Catahoula Lake 1, in 22-7n-4e, flowed 108 barrels from Wilcox sand, Eocene 4012-14 feet, 32-gravity, 7/32-inch, completed 7-20-51, TD 5400.

**Morehouse Parish, Beekman field.** Justiss Mears Oil Company et al's Crossett Timber & Development Company 1, in 6-22n-6e, flowed 42 barrels from Cotton Valley sand, Jurassic 3649-56 feet, 46.5-gravity, 3/16-inch, completed 8-17-51, TD 3818.

### NORTH LOUISIANA—NEW OIL PAY

**Union Parish, Downsville field.** Phillips Petroleum Company's Roberts 1, C SE SE NW 10-19n-1e, flowed 365 barrels from Travis Peak lime, Lower Cretaceous 7418-24 feet, 41-gravity, ¼-inch, completed 8-30-51, TD 7575.

### NORTH LOUISIANA—NEW GAS PAY

**Caddo Parish, Elm Grove field.** Otis D. Coston's C. M. Hutchison 1, in 27-16n-12w, flowed 0.2-million from Woodbine sand, Cretaceous 2460-68 feet, ¼-inch, completed 8-21-51, TD 5520.

### SOUTH LOUISIANA—NEW DISTILLATE FIELD

**Terrebone Parish.** Magnolia Petroleum Company's State Lease 794-1-A, Block 20-S, State Lease 794, flowed 42 barrels and 4.8-million from 8182-92 feet, 50.6-gravity, ⅛-inch, completed 8-23-51, TD 11,296.

### SOUTH LOUISIANA—NEW DISTILLATE PAY

**West Baton Rouge Parish, Grosse Tete field.** Sohio's A. Wilbert & Sons B-2A, in 31-7s-11e, flowed 56 barrels and 2-million from 9696-9705 feet, ¼-inch, TD 9942.

### SOUTH LOUISIANA—NEW GAS FIELD

**Plaquemines Parish.** Shell Oil Company's State Lease 1961-1, State Lease 1961, in 18s-18e, no gauge from 7507-20 feet, completed 8-15-51, TD 10,000.

### MICHIGAN—NEW GAS FIELD

**Newaygo County.** Augie Busk's Hatchew Commission 1, E½ SW NW 29-12n-11w, Croton Township, flowed 1.7-million from Marshall sand, Mississippian 916-19 feet, TD 919.

### MONTANA—OIL FIELD EXTENSION

**Toole County, Kevin field.** The Texas Company's A. Swayze 10, SW NE SE 34-36n-2w, 1-mile west extension, pumped 14 barrels and 72 barrels water from Madison sand, Mississippian 1769-1811 feet, completed 8-12-51, TD 1811.

### NEBRASKA—NEW OIL FIELD

**Kimball County.** Nebraska Drillers Incorporated's Torgeson 1, SE NW NW 23-14n-56w, pumped 240 barrels from Dakota "J" sand, Cretaceous 6526-40 feet, TD 6540.

### NEBRASKA—OIL FIELD EXTENSION

**Banner County, Harrisburg field.** Stanolind Oil & Gas Company's T. D. Lovercheck 2, NE SE 18-18n-55w, 2½-mile south extension, pumped 33 barrels from Upper Muddy sand, Cretaceous 5934-44 feet, 36-gravity, completed 8-1-51, TD 6109.

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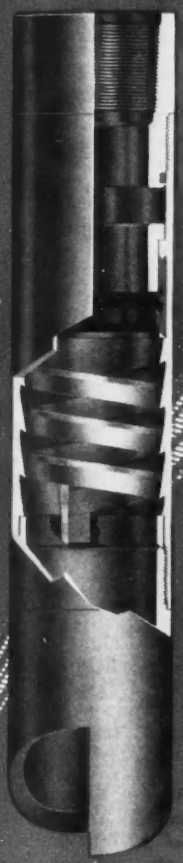

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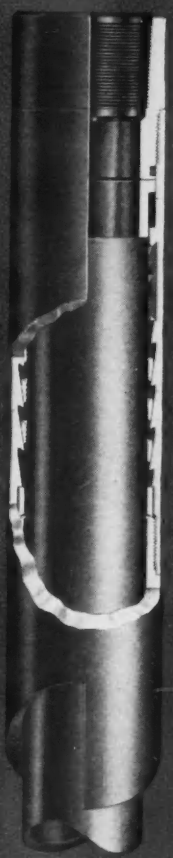

View showing Bowen-ITCO Casing Patch with protector ring in position.

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## NEW MEXICO—NEW OIL FIELDS

**Eddy County.** Miller Brothers Oil Company's State-Jones-Watkins 1, in 5-19s-29e, pumped 5 barrels from San Andres lime, Permian 2751-85 feet, 36-gravity, completed 8-29-51, TD 2785.

**Lea County.** Skelly's Mexico-State 1-J, in 32-24s-38e, flowed 583 barrels from Ellenburger lime, Ordovician 10,210-230 feet, 41.8 gravity, ¾-inch, completed 8-24-51, TD 10,245.

The Texas Company's State AS-1, in 6-15s-32e, flowed 1418 barrels and 5 barrels water from Wolfcamp lime, Permian 9700-26 feet, 41.5-gravity, ½-inch, completed 8-15-51, TD 9802.

## OKLAHOMA—NEW OIL FIELDS

**Jackson County, Carmel field.** Sun Oil Company's Hulett Robinson 1, SE SE NW 34-1s-22w, pumped 15 barrels from Strawn lime, Pennsylvanian 5354-72 feet, 41-gravity, TD 5454.

**Lincoln County, Mammoth, Northeast field.** The Texas Company's R. A. Roberts 1, SW SW NW 34-13n-3e, flowed 55 barrels from Senora sand, Pennsylvanian 4542-49 feet, 36-gravity, 1-inch, TD 4945.

**Logan County.** W. F. Catlett et al's Dora Giddings 1, SE NE NW 21-17n-1e, flowed 296 barrels from 2nd Wilcox sand, Ordovician 5070-82 feet, 48-gravity, ⅜-inch, TD 5082.

**Payne County.** W. H. Martgan's Manning 1, NE NE NW 20-18n-6e, flowed 50 barrels and 24 barrels water from Red Fork sand, Pennsylvanian 3056-62 feet, 38-gravity, ½-inch, TD 3103.

**Pottawatomie County.** Herman Brown's Walker 1, SW NE SW 18-7n-2e, pumped 233 barrels from 2nd Wilcox sand, Ordovician 6134-49 feet, 34.5-gravity, TD 6149.

**Seminole County, Sancho, North field.** Flynn Oil Company's Best 1, NW NE NE 32-9n-7e, flowed 32 barrels from Booch sand, Pennsylvanian 3394-3419 feet, 40-gravity, 9/16-inch, TD 3419.

**Stephens County.** Christie-Stewart's Mable Saunders 1, NE NE NW 3-3s-6w, pumped 2 barrels and 2 barrels water from 1888-1906 feet, 32-gravity, TD 1952.

Continental Oil Company's Adams-Von Weise 1, NW SW NW 15-2s-4w, pumped 86 barrels from Eason sand, Pennsylvanian 3568-3600 feet, 27.4-gravity, TD 6832.

## OKLAHOMA—NEW OIL PAYS

**Creek County, Stroud field.** Delta Petroleum Corporation et al's Walker 1, SW NW NE 16-14n-7e, pumped 157 barrels from 2nd Wilcox sand, Ordovician 3968-83 feet, 36-gravity, TD 3983.

**Payne County, Cushing Lake field.** H. Waggoner & Company's Jenkins 1, NW SW NE 33-18n-4e, pumped 15 barrels from Skinner sand, Pennsylvanian 3542-47 feet, 41-gravity, TD 4155.

**Stephens County, Velma field.** Skelly's Wirt Franklin 32, NE SE SE 34-1s-5w, flowed 147 barrels from Springer sand, Pennsylvanian 3740-67 feet, 40.5-gravity, 7/32-inch, TD 3842.

## OKLAHOMA—OIL FIELD EXTENSIONS

**Creek County, Cushing, East field.** Robert C. Davis & E. L. Oliver's Briggs 1, NW SW NW 21-19n-8e, ½-mile east extension, flowed 45 barrels from Red Fork sand, Pennsylvanian 2632-40 feet, ¼-inch, TD 2671.

**Lincoln County, Davenport, West field.** Puckett Drilling Company et al's Edda B. Meyer 1, SE SE SE 18-14n-5e, ½-mile south extension, flowed 120 barrels from Prue sand, Pennsylvanian 3605-23 feet, 44-gravity, TD 3623.

**Major County, Ringwood field.** Superior Oil Company's Smithson 21-14, NE NW NW 14-22n-11w, 2½-mile north extension, flowed 11 barrels from Manning sand, Pennsylvanian 6727-83 feet, TD 6824.

**Oklahoma County, Britton field.** Josaline Production Company & Ashland's Haney 1 (OWWO), NE NE NW 19-13n-3w, ¾-mile northwest extension, flowed 12 barrels from Bartlesville sand, Pennsylvanian 6452-64 feet, 9/32-inch, TD 6970.

**Stephens County, Knox field.** Skelly's H. E. Sadler 1, NE NE NW 11-2n-5w, pumped 148 barrels from 1830-45 feet, 34.7 gravity, TD 2775.

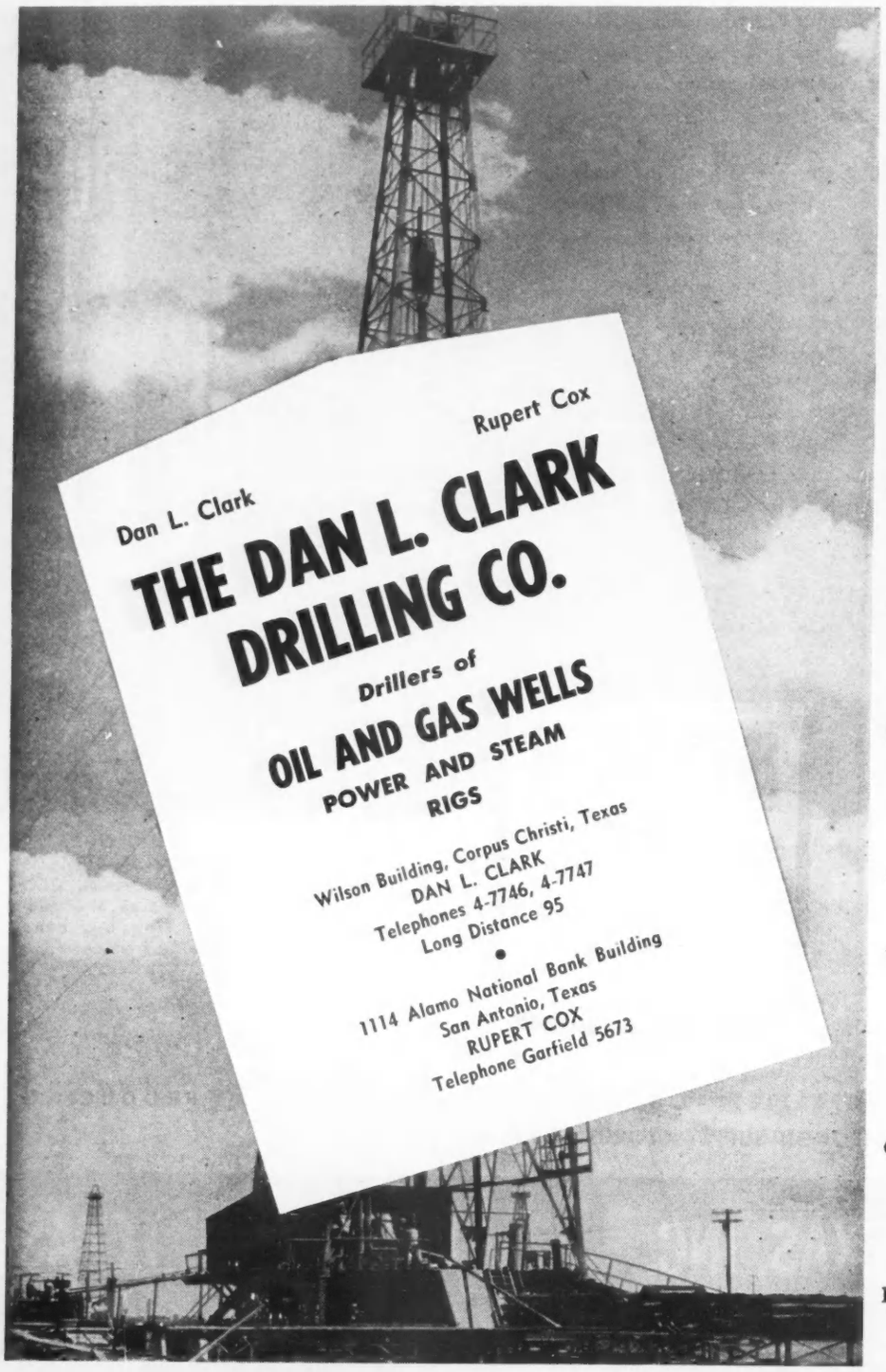
**Washita County, Elk City field.** United Carbon Company's Z. Music 1, C NW SE 28-10n-20w, ¾-mile east extension, flowed 101 barrels from Granite Wash, Pennsylvanian 9684-9772 feet, 61.2-gravity, 9/64-inch, TD 11,075.

## OKLAHOMA—NEW DISTILLATE FIELD

**Grady County.** Magnolia's Charles Maurer 1, C NW SE 21-5n-5w, flowed 39 barrels and 2.3-million from Springer sand, Pennsylvanian 10,421-554 feet, 53.3-gravity, TD 11,336.

## OKLAHOMA—NEW GAS FIELD

**Pontotoc County.** Jones-Shelburne & Finston & Company's Wilson 2, SW NE SW 26-4n-5e, flowed 2-million from 549-555, TD 2340.

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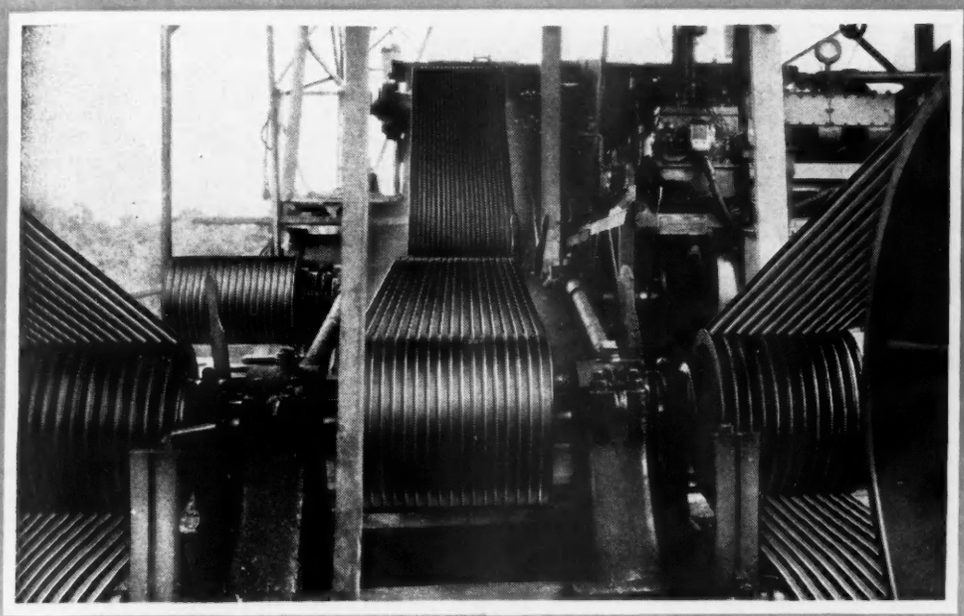

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### TEXAS DISTRICT 1—NEW OIL FIELDS

**Frio County.** Goldston Oil Company's Anna Weitting 1, Dan Price Survey, pumped 11 barrels from Navarro sand, Upper Cretaceous 3682-3725 feet, 44-gravity, completed 8-9-51, TD 4079.

**Milam County.** D. H. Byrd's M. Blakely 1, A. J. Watts Survey, pumped 20 barrels from Edwards lime, Lower Cretaceous 5736-39 feet, 31.4-gravity, completed 7-25-51, TD 5739.

### TEXAS DISTRICT 1—OIL FIELD EXTENSIONS

**Caldwell County, Buchanan field.** Riddle Oil Company's A. J. Miears 4, Nick Kelly Survey, ½-mile northwest extension, pumped 44 barrels from Dale lime, Cretaceous 1980-81 feet, 39-gravity, completed 7-30-51, TD 1981.

**Frio County, Pearsall field.** Midstates Oil Corporation's John W. Harris 1, Heirs of William Strope Survey, ¾-mile east extension, flowed 70 barrels from Austin chalk, Upper Cretaceous 5386-5777 feet, 28-gravity, 3/16-inch, completed 8-11-51, TD 5777.

**McMullen County, Campana, South field.** The Texas Company's Henry E. Gouger Fee (NCT-2) 2, BS&F Survey, ½-mile southwest extension, pumped 59 barrels from 3050-54 feet, 21.4-gravity, completed 7-28-51, TD 3054.

### TEXAS DISTRICT 2—NEW OIL FIELD

**Calhoun County.** Alcoa Mining Company's Mary A. Hubbard 1-B, George H. Hall Survey, flowed 201 barrels from 8707-11 feet, 39.4-gravity, 5/32-inch, completed 8-5-51, TD 8744.

### TEXAS DISTRICT 2—NEW OIL PAYS

**Bee County, Plummer field.** Midstates' Zeno Barber 1, C. B. Shain Survey, flowed 106 barrels from Slick sand, Eocene 6688-6700 feet, 3/16-inch, completed 8-4-51, TD 7110.

**Calhoun County, Long Mott, East field.** Quintana Petroleum Corporation's W. C. Melbourn 1, I&GN RR Company Survey, flowed 122 barrels from 7800-06 feet, 42-gravity, ⅛-inch, completed 8-7-51, TD 9192.

### TEXAS DISTRICT 2—OIL FIELD EXTENSIONS

**DeWitt County, Helen Gohlke field.** Henshaw Brothers Oil Company's J. B. Wells 1, Robert Burns Survey, ½-mile northeast extension, flowed 167 barrels from 8150-57 feet, 34-gravity, ⅛-inch, completed 8-4-51, TD 8195.

**Jackson County, Francitas, North field.** Sun's Wood Unit 1, Maria de Jesus Leal Grant, ¾-mile east extension, flowed 164 barrels from 8818-22 feet, 50.2 gravity, 7/64-inch, completed 8-7-51, TD 9500.

### TEXAS DISTRICT 2—NEW DISTILLATE FIELD

**Bee County.** Newman Brothers Alaska Steamship Company et al's Charles Mengers 2, Block G, Garcia Survey, no gauge from 4800-20 feet, completed 8-19-51, TD 4930.

### TEXAS DISTRICT 2—NEW DISTILLATE PAY

**DeWitt County, "Henze" field.** Rowan & Hope Oil Company's H. C. Gansow 1, Jose Santos Survey, flowed 18 barrels and 10.5-million from Wilcox sand, Eocene 7422-35 feet, 52.9-gravity, completed 8-6-51, TD 7594.

### TEXAS DISTRICT 2—DISTILLATE FIELD EXTENSION

**Live Oak County, Clayton field.** Magnolia's Block 86 Unit 1, Section 86, Survey 20, southwest extension, flowed 90 barrels and 4.4-million from 6935-55 feet, 60.3-gravity, completed 8-19-51, TD 8400.

### TEXAS DISTRICT 2—NEW GAS PAY

**Victoria County, Battle field.** Morris Cannan, Hawn Brothers & Liebman & Gibson Drilling Company's Pedro Pardo 2, P. Gallardo Survey, flowed 19-million from Stillwell sand, Oligocene 4879-85 feet, open, completed 8-2-51, TD 5256.

### TEXAS DISTRICT 3—NEW OIL FIELDS

**Chambers County, Fig Ridge, North field.** Sun's R. L. White 1, T&NO Survey, flowed 109 barrels from Frio sand, Oligocene 8198-8206 feet, 35.7-gravity, ⅛-inch, completed 8-24-51, TD 9600.

**Colorado County.** The Ohio Oil Company's W. K. Lehrer et al 1, Naham Mixon Survey, pumped 23 barrels from 6180-90 feet, 36.4-gravity, completed 8-25-51, TD 9946.

**Madison County.** The Texas Company's W. M. Forrest 1, Samuel Larry Survey, flowed 149 barrels from Buda lime, Lower Cretaceous 9017-36 feet, 38.4-gravity, 5/32-inch, TD 9036.

### TEXAS DISTRICT 3—NEW OIL PAYS

**Harris County, Goose Creek field.** Carter Taylor's Otis E. Donahoe 1, Lot 8,

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**UNITED STATES STEEL**

Block 15, Jones Addition to Pelly Townsite, Harvey Whiting Survey, flowed 85 barrels from 4617-20 feet, 29-gravity, 7/64-inch, completed 8-18-51, TD 4667.

**Liberty County, Liberty Townsite field.** Floyd Karsten's Geraldine Humphries 1, East League of Liberty Townsite, flowed 94 barrels from 9085-9140 feet, 42.3-gravity, ⅛-inch, completed 8-16-51, TD 9500.

### TEXAS DISTRICT 3—NEW GAS FIELDS

**Fort Bend County.** R. E. Hibber & J. R. Butler's Gulf Oil Corporation Fee 2, John Lafayette League, flowed 2.9-million from 7553-7620 feet, ¼-inch, completed 8-8-51, TD 7905.

**Wharton County.** Mac Drilling Company's Joe Tobola 1, I&GN RR Survey, flowed 3-million from 3907 feet, 5/16-inch, TD 4560.

### TEXAS DISTRICT 3—NEW GAS PAY

**Harris County, Durkee, South field.** Union Producing Company's Hurt 1, Phillip Thompson Survey, flowed 3.7-million from Hurt sand, Eocene 7910-30 feet, ¼-inch, completed 8-1-51, TD 8010.

### TEXAS DISTRICT 4—NEW OIL FIELDS

**Duval County.** F. William Carr et al's A. G. Black 1, Pedro de la Cerda Survey, flowed 88 barrels from Lower Pettus sand, Eocene 4432-36 feet, 44-gravity, ⅛-inch, completed 8-5-51, TD 4437.

**Jim Hogg County.** Sun's Weil Brothers 21, Santo Domingo de Abajo Grant, pumped 40 barrels from Hockley sand, Eocene 4123-34 feet, 42.6-gravity, completed 8-11-51, TD 5704.

### TEXAS DISTRICT 4—NEW OIL PAYS

**Nueces County, Dagger Island field.** Sunray Oil Corporation's State Tract 394-1, State Tract 394, Corpus Christi Bay, flowed 199 barrels from 8330-37 feet, 40.5-gravity, completed 7-30-51, TD 8400.

Sunray's State Tract 395-1, State Tract 395, Corpus Christi Bay, flowed 162 barrels from "5-B" sand, 8345-52 feet, 38.9-gravity, 5/32-inch, TD 8400.

**Red Fish Bay field.** Atlantic Refining's State Tract 413-1, State Tract 413, flowed 108 barrels from 10A sand, 7950-60 feet, 39.6-gravity, ⅛-inch, completed 8-30-51, TD 8400.

### TEXAS DISTRICT 4—NEW GAS FIELDS

**Hidalgo County, Los Torritos field.** Taylor Refining Co. & Mayfair Minerals Incorporated's William Brewster 1, Los Torritos Grant, flowed 12-million from 6746-51 feet, open, completed 8-30-51, TD 9496.

**Kenedy County.** Humble's John G. Kenedy, Junior 1-E, El Paistle Grant, flowed 10-million from production interval not reported, open, completed 8-7-51, TD 11,794.

**Starr County.** Sun's Hinojosa 1, Santa Cruz Grant, flowed 11-million from 6133-6145 feet, open, completed 8-25-51, TD 4939.

### TEXAS DISTRICT 4—GAS FIELD EXTENSION

**Nueces County, Bishop, West field.** Eastern States Petroleum Company Incorporated's H. A. Pearson 1, F. Z. Bishop Subdivision, Weil Ranch, ½-mile southeast extension, flowed 2.2-million from Middle Pfluger sand, Oligocene 7211-14-feet, 64-gravity, open, and 11.5-million from Lower Pfluger sand, Oligocene 7231-46 feet, 56-gravity, open, completed 7-15-51, TD 7805.

### TEXAS DISTRICT 5—NEW OIL FIELD

**Grayson County.** Standard Oil Company of Texas' S. F. McKeon 1, A. Humes Survey, pumped 67 barrels and 3 barrels water from Strawn sand, Pennsylvanian 5126-34 feet, 35.4-gravity, completed 8-15-51, TD 6000.

### TEXAS DISTRICT 5—NEW OIL PAY

**Grayson County, Sandusky field.** Kay Kimbell's E. R. Miller 1, P. B. Bruce Survey, flowed 80 barrels from Ellenburger lime, Ordovician 7687-99 feet, 41.2-gravity, 3/16-inch, completed 8-23-51, TD 7803.

### TEXAS DISTRICT 5—OIL FIELD EXTENSIONS

**Kaufman County, Walter Fair field.** C. H. Murphy's Priddy 1, G. B. Mason Survey, south extension, flowed 100 barrels from Paluxy sand, Lower Cretaceous 4937-68 feet, 30.2-gravity, ¼-inch, completed 8-10-51, TD 4968.

**Leon County, Buffalo field.** J. K. Dobbs' Roy Smith et al 1, E. W. Boykin Survey, ½-mile northeast extension, flowed 10 barrels from Woodbine sand, Cretaceous 5683-86 feet, 29-gravity, ½-inch, completed 8-29-51, TD 5711.


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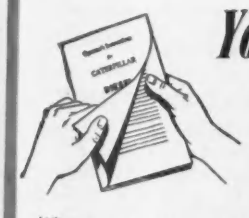

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### TEXAS DISTRICT 6—NEW OIL FIELD

**Wood County, Shirley-Barbara field.** A. O. Phillips et al's D. E. Dobbs 1, Thomas Walker Abstract 602, flowed 276 barrels from Sub-Clarksville sand, Upper Cretaceous 5540-50 feet, 27.7-gravity, ¼-inch, completed 8-4-51, TD 7135.

### TEXAS DISTRICT 6—NEW DISTILLATE FIELD

**Houston County, Ralph Spence field.** Alton Coats & Ralph Spence's O. M. Rialls 1, McLean Survey, flowed 128 barrels and 2-million from Price sand, Upper Cretaceous 5764-70 feet, 60-gravity, ¼-inch, completed 8-21-51, TD 6010.

### TEXAS DISTRICT 7-C—NEW OIL FIELDS

**Crockett County.** Malco Refineries, Incorporated et al's George Bean 1, Section 34, Block UV, GC&SF Survey, pumped 50 barrels from 1460-67 feet, 28.2-gravity, completed 8-24-51, TD 1467.

**"Block 44-Shallow" field.** C. E. Marsh's II, University 1, Section 7, Block 44, University Lands Survey, pumped 47 barrels from 1729-53 feet, 29.6 gravity, completed 8-15-51, TD 1753.

**Reagan County.** Lloyd H. Smith, Incorporated & G. P. Livermore, Incorporated's D. E. Hughes 1-A, Section 23, Block F, C&M RR Survey, pumped 40 barrels from Spraberry sand, Permian 5799-5870 feet, 38.1-gravity, completed 8-19-51, TD 5870.

James H. Snowden et al's Gidney 1-37, Section 37, Block 36, T-5-S, T&P Survey, flowed 225 barrels from Spraberry sand, Permian 6447-95 feet, 37.3-gravity, ½-inch, completed 8-4-51, TD 6495.

Stanolind's F. E. Wade, 1-A, Section 213, Block 2, T&P Survey, pumped 5 barrels from Spraberry sand, Permian 5890-5922 feet, 37.6-gravity, completed 8-22-51, TD 5922.

**Runnels County.** Cabot Carbon Company & Warren Oil Corporation's Theodora Frick et al 1, Section 78, CTRR Survey, pumped 30 barrels from Palo Pinto lime, Pennsylvanian 3831-4766 feet, 42-gravity, completed 8-15-51, TD 4766.

**Schleicher County, "Nova West" field.** Wesley West's Christene Mittel et al 1, Section 77, Block TT, TCRR Survey, flowed 583 barrels from Strawn sand, Pennsylvanian 6317-37 feet, 45-gravity, 9/32-inch, completed 8-17-51, TD 6372.

### TEXAS DISTRICT 7-C—NEW OIL PAY

**Runnels County, Davis field.** T. W. Murray's P. M. Davis 1, EL&RR Survey, pumped 66 barrels from Upper Gardner sand, Pennsylvanian 4196-4565 feet, 41-gravity, completed 8-7-51, TD 4565.

### TEXAS DISTRICT 7-C—NEW GAS FIELD

**Runnels County.** Mid-Continent Petroleum Corporation's B. R. Thetford 1, Wharton CSL Survey, flowed 8.3-million from Morris sand, Pennsylvanian 3682-3715 feet, completed 8-16-51, TD 4229.

### TEXAS DISTRICT 8—NEW OIL FIELDS

**Andrews County.** Kerr-McGee Oil Industries, Incorporated's University 1-B, Section 23, Block 11, University Lands Survey, flowed 232 barrels from Wolfcamp lime, Permian 7956-70 feet, 43-gravity, 7/32-inch, completed 7-31-51, TD 9297.

**Crane County.** Humble's Jax M. Cowden et al 3, Section 47, Block X, CCSD & RGNG Survey, pumped 65 barrels from Fusselman lime, Silurian 7388-7425 feet, 42.5-gravity, completed 8-26-51, TD 8984.

**Gaines County.** Magnolia's Gertrude Chilton 1, League 288, Gray CSL Survey, pumped 472 barrels from Pennsylvania sand, Pennsylvanian 11,334-375 feet, 38.2-gravity, completed 8-21-51, TD 12,437.

**Martin County.** Tide Water Associated Oil Company's E. B. Dickenson 1, Section 44, Block 37, T-1-N, T&P Survey, flowed 235 barrels from Ellenburger lime, Ordovician 12,087-105 feet, 51.5-gravity, ½-inch, completed 8-16-51, TD 12,135.

**Pecos County.** Helmerich & Payne Incorporated's Lowery & Wilson 1-F, Section 19, Block Z, TCRR Survey, pumped 59 barrels from San Andres lime, Permian 2000-19 feet, 33.8-gravity, completed 7-31-51, TD 2019.

**Scurry County.** Imperial Production Company's Vernon B. Cox 1, Section 699, Block 97, H&TC Survey, pumped 242 barrels from Canyon Reef lime, Pennsylvanian 7120-34 feet, 41.6-gravity, completed 8-3-51, TD 7134.

**Yoakum County.** York & Harper, Incorporated's J. E. Wright 1, Section 13, Block D, J. H. Gibson Survey, flowed 354 barrels from Glorietta lime, Permian 5940-6007 feet, 27-gravity, ½-inch, completed 8-12-51, TD 6007.

### TEXAS DISTRICT 8—OIL FIELD EXTENSION

**Glasscock County, Weiner-Floyd field.** Paul F. Barnhart's J. O. Bigby 1-10, Section 10, Block 36, T-5-S, T&P Survey, north extension, flowed 406 barrels from Spraberry sand, Permian 6710-6808 feet, 37.5-gravity, ⅜-inch, completed 8-3-51, TD 6808.

### UTAH—NEW OIL FIELD

**Duchesne County, Duchesne field.** Carter Oil Company's Ute-Tribal 1, C SE NE 17-4s-4w, flowed 538 barrels from Upper Wasatche sand, Eocene 7215-7596 feet, 42.9-gravity, 1-inch, completed 8-11-51, TD 7596.

### WYOMING—NEW OIL FIELD

**Johnson County, Sussex, West field.** Continental's Unit 1, NW SE NW 8-42n-79w, flowed 450 barrels from Sussex sand, Upper Cretaceous 2850-2950 feet, 39.5-gravity, open, completed 8-22-51, TD 6160.

### WYOMING—NEW OIL PAY

**Converse County, Glenrock field.** Phillips' McNeil 1, SW NE NW 4-33n-75w, pumped 273 barrels from Dakota sand, Cretaceous 6954-90 feet, 36.6-gravity, completed 8-11-51, TD 9540.

### WYOMING—OIL FIELD EXTENSION

**Laramie County, Borie field.** The California Company's State 1, SW SE SW 24-13n-68w, 1⅛-mile south extension, flowed 175 barrels from Muddy sand, Cretaceous 8764-8847 feet, ½-inch, completed 8-10-51, TD 8847.

# Insurance Problems Of the Drilling Contractor

*Contractor's Cost Clinic, No. 4*

By J. H. JOHNSON, Broaddus-Goff Insurance, Oklahoma City

**THE PURCHASE of insurance is a critical venture for the average drilling contractor. The following article is offered as a simple, workable guide to be used in the requisitioning of insured protection.**

WRITING insurance for the drilling contractor has been an individual problem up to the present. Now, because of competitive conditions, contractors should work together to satisfactorily solve their problems; and above all they should make every effort to enforce all safety rules and regulations which will contribute to a reduction of loss experience; make a careful study of insurance markets and coverages, and endeavor to better acquaint the insurance underwriters with oil drilling operations so as to overcome any apprehension on the part of the underwriters.

In general, drilling contractors are posed with the same insurance problems as are merchants or manufacturers who have only a limited working knowledge of the fundamental principles of insurance coverage. Drilling contractors rely on insurance agents for advice and protection, but the agent writes many kinds of insurance protection and, as a rule, it is difficult for him to devote sufficient study to render him an expert in working out the type insurance which the drilling contractor needs and must have in order to operate.

Drilling contractors should consider four main factors when buying insurance:

- Quality
- Quantity
- Adequacy
- Cost

Quality is imperative and most important. It should govern the selection of the contractor's insurance agent or broker who must be fully qualified and informed and who has access to the largest and best insurance markets. The right man having been selected, he should be given full responsibility for all insurance coverage. Drilling contractors have lawyers to attend to their legal matters, but their business may be in a very precarious condition if their insurance is not bought with care. The time to determine the quality and collectibility of an insurance policy is prior to a loss, not after. Contractors should guard against the error of determining their insurance by the cost thereof. There is no cheap insurance.

Quantity, Adequacy and Cost are of little value if the insurance company is not solvent or the policy does not cover all the hazards upon which coverage is necessary and desired. The Insurance Department of any state can provide reliable information as to the solvency of the insurance company insuring against loss within the state, or the information can be obtained from various insurance publications.

Quantity is the amount of coverage purchased to insure property against fire, windstorm, and similar hazards. Property should be covered for an amount equal to its current cost less normal depreciation, otherwise known as replacement value. When underinsured, the contractor runs the risk of losing the difference between the amount of insurance placed on the property and the actual value thereof.

Adequacy refers to the liability protection which should be sufficiently high and broad enough to include all hazards against which the contractor desires to be insured. Under liability insurance it is not easy to advise as to the adequacy of coverage. A study of the operations and hazards to be insured against should be made prior to determining the policy limits. Also, it cannot be foretold what a jury may grant a claimant when awarding judgment. Court decisions in the territory where operations are being performed will be the best guide as to the adequacy of limits for liability protection.

Cost is a factor where the rates charged are for the most part fixed by the loss experience of the individual and the industry as a whole.

Because of the nature of his operations the drilling contractor should purchase insurance to cover the following:

- Fire
- Workmen's compensation
- General public liability
- Automobile liability
- Contractual liability
- Owner's contingent liability

### Fire Insurance

In writing fire, windstorm, etc., protection covering drilling equipment, the coverage is generally placed under an Inland Marine policy so that the property can be insured wherever located and while in transit. Oil companies are requiring drilling contractors to insure all property brought upon the premises of the owner and the policy must be endorsed so as to waive any subrogation rights of the insuring company against the owner or oil company.

For the drilling contractor's benefit, the coverage should be written for amounts which will give him full protection in connection with the coinsurance clause which may be attached to his policy. In most states the drilling contractor has a 100 percent clause attached to his policy and he must, therefore, be sure that the amount he places on his drilling equipment be equal to 100 percent of its new replacement value, less normal depreciation.

It is suggested that the drilling contractor, in writing this coverage, have the insurance clause written so as to cover all property upon which insurance is required and necessary, and then exclude that property which he may not wish to insure.

Fire insurance is very important since it protects a considerable por-

tion of the drilling contractor's investments.

### Workmen's Compensation

All states require drilling contractors to carry some form of Workmen's Compensation insurance. Workmen's Compensation, written by an insurance company admitted to transact business in the state, is permitted in most states. In some states, if the insured has purchased his insurance from such admitted insurance company, it relieves him from further responsibility under the Workmen's Compensation Law, even though the insuring company may not be financially responsible. When an insurance company has been admitted to transact business in a given state and covers a risk, its responsibility is to see that all claims are handled and judgments satisfied.

When writing insurance through the insured plan there are many types other than the strictly manual rate or guaranteed premium.

The guaranteed premium is probably the most popular and most generally accepted since the premium is regulated by the state through a published rate for the type of work being performed. There is a deviation from this in that if the experience of the assured is good, rates will be reduced; and likewise, if the experience is bad, the rates will be increased accordingly. Three retrospective rating plans have come into use during the last few years and appear satisfactory for a large assured with a reasonably good loss experience.

Under compensation insurance, state laws specify the limits for those employes who come under the act, but employes who do not have this protection of the law come under Employer's Liability Insurance. Employer's Liability with limits of $25,000 is provided in, and made a part of, the Workmen's Compensation policy when the insurance is purchased under the insured plan.

A few states require what is known as Compulsory State Fund for the writing of Workmen's Compensation Insurance. This protection is administered by the state and the state must protect the insured against all accidents covered by the law which arise out of the insured's operations.

There are those states which have a state fund for the writing of Workmen's Compensation Insurance, but it is not mandatory that the insurance be written through the state.

Most states permit self-insuring of workmen's compensation upon qualification as to financial responsibility. Few drilling contractors have found it necessary or advisable to use self-insurance.

### General Public Liability

General Public Liability has become a requisite insurance requirement for the drilling business during the last few years. This coverage, being a legal liability coverage, is versatile and has many opportunities of endorsement, enabling it to cover the many and varied hazards confronting the insured. It is undoubtedly one of the most flexible types of coverage and can be made to meet almost any public liability problem.

During the drilling of an oil well there are many types of accidents which may occur: injury to the visitor who comes to the well, children playing around the well when operations are in progress, injury or death to animals, damage to crops and to property arising from pollution, and damage to the adjacent underground oil reservoir.

General Public Liability is usually written under what is known as the Comprehensive General Public Liability policy, and it should meet most of the drilling contractor's liability. Under this form can be included many legal liabilities such as: Contractual Liability; Owner's, Landlord's, and Tenant's Liability; Teams Liability; Owner's Contingent Liability; Elevator Liability, etc.

It would be wise for drilling contractors to see that their subcontractors carry insurance at least equal to that required of them.

### Automobile Liability

Automobile Public Liability and Property Damage insurance is written in the name of an insured, but with the additional feature that it applies not only to the named insured but also to the person responsible for the operation of the car with the given consent of the insured. This means, in effect, that if the named insured lends his automobile to another person who then injures the named insured or others while driving the car, the policy will protect the borrower to the extent of his legal liability. This policy, being a legal liability policy, protects the named insured for liability for damage to the person and property of others to the limits of liability set out in the policy.

There are many changes being made at the present time in automobile coverage and it will be necessary to study these changes as they are announced in order to keep abreast of the subject.

### Contractual Liability

This is a form of coverage used to protect the insured against legal liability assumed by him when entering into contracts, and is imperative when the drilling contractor agrees to the hold-harmless clause found in so many drilling contracts today. This coverage may be included in the Comprehensive General Public Liability policy.

### Owner's Contingent Liability

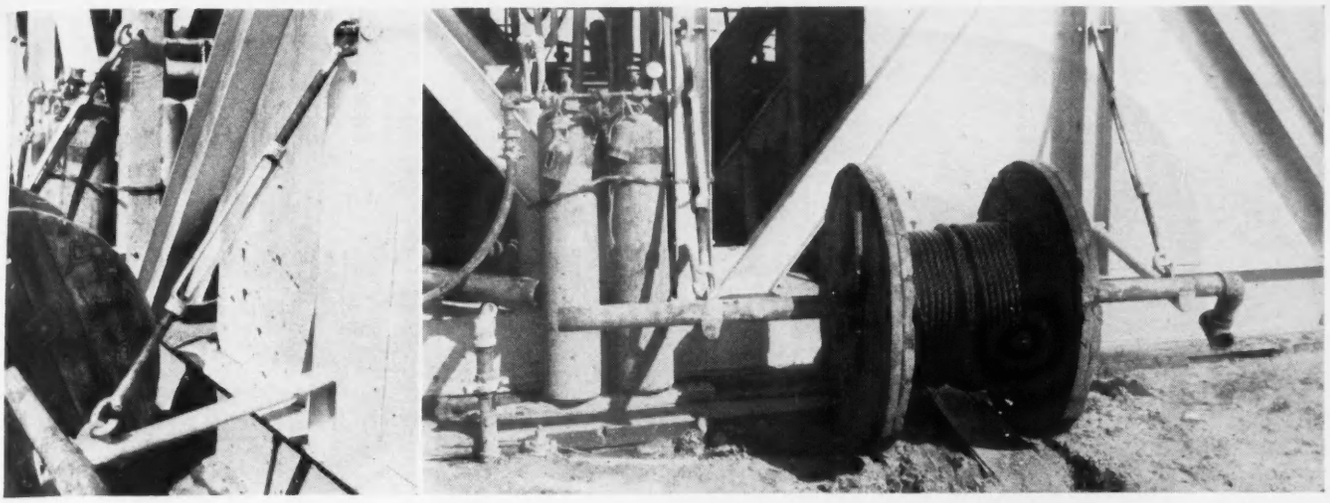
This is a liability coverage required by some oil companies and is written in the name of the owner but is purchased by the drilling contractor. It protects the owner from legal liability and law suits which arise from the operations of the drilling contractor, and is required in preference to the contractual liability coverage where the contract does not include the hold-harmless clause. It is designed to protect the owner and may be added to the Comprehensive Public Liability policy.

It is recommended that all liability coverage be written with high limits ($100,000 per accident) since the additional cost for the higher limits is relatively small for the additional protection afforded.

It is imperative that all accidents be reported to the insurance carrier at once. Delay may cost the insured and his insurance carrier more than necessary due to a late investigation. Prompt reports are necessary to the insurance company of all accidents which occur at the location, regardless of whether they arise out of the insured's operations. Do not discuss or settle any claim which comes within the insurance coverage, as this is the responsibility of the insurance carrier. Should a claim be settled by the insured, the insurance company would be within its rights to deny liability.

To assist the insurance carrier it is advisable to obtain all information possible at the scene and time of the accident. An insured, or his employes, should never accept responsibility for an accident but should leave that to the insurance carrier.

Upon the drilling contractor and the underwriter fall the loss experience of the drilling industry. If close observance of all safety practices is followed by the drilling contractor, and careful and conservative adjustments are made of all claims by the underwriter's adjusters, experience should be developed which would warrant a much lower insurance cost for the drilling contractor.



LEFT. Side view of one of the supports shows manner in which unit is hung from bolts run through holes in webs of H-beam columns of rig substructure. RIGHT. A pair of turnbuckles, two horizontal pipe arms and a three-inch pipe axle are all that is required to build this convenient, easily-handled wire line storage spool support. This type of installation simplifies rigging-up and pulling over of new line.

# Substructure Support Facilitates Rig Handling

By GILBERT M. WILSON
WORLD OIL Staff

**A METHOD of raising and suspending the wire line reel has been developed which eliminates jacks or rig hoisting equipment. The author illustrates the salient points of this design, and gives details which enable its construction by any competent welder.**

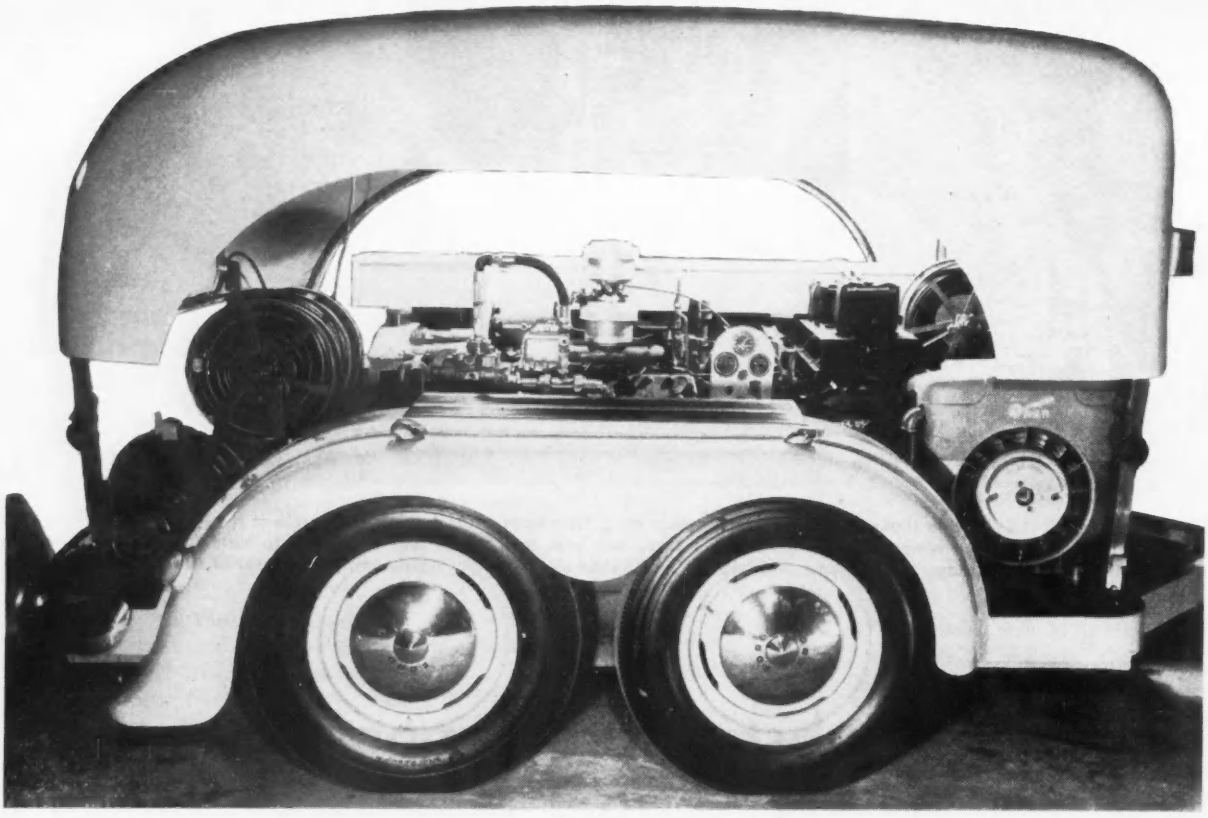
A PRACTICAL and inexpensive method for supporting the wire line storage spool has numerous advantages over some types used on drilling rigs. The equipment requires only a pair of fairly heavy turnbuckles, a few pieces of salvaged two- and three-inch pipe and some miscellaneous scrap materials.

As can be seen, the hangers may be attached to any two conveniently situated columns on the side of the rig substructure. The weight of the spool is taken up by two 1¼ x 18-inch turnbuckles. The near-horizontal arms or spacer bars which hold the spool away from the side of the rig are 36-inch lengths of two-inch pipe. The turnbuckles are hung on seven-eighths inch bolts which are run through holes drilled or burned in the webs of the H-beam columns. A piece of the eye is cut out of the side of each of the lower ends of the turnbuckles to permit hooking into lifting eyes welded to the lower supporting arms.

The axle which is run through the spool is a length of three-inch line pipe, resting on reinforced, V-shaped notches burned out of the top surface at the ends of the two-inch pipe arms. Pivoting of these arms at the H-beam columns is done by welding a short piece of one-inch pipe—the length being such that it will fit between the webs—to the ends of the arms. The seven-eighths-inch bolt is then run through this bushing and the holes in the H-beam column webs. A large washer is welded to the end of each of the bolts to prevent it being pushed on through the holes.

The advantages of this type of spool support are readily apparent. The unit takes up little yard space and no jacks or blocking are required to support the heavy spool, which in this particular instance was a 1750-foot spool of one-inch line. The spool is lifted by first loosening the turnbuckles sufficiently to allow the arms to be lowered to a level slightly below that of the three-inch pipe axle. The spool then is rolled over to the proper position, the axle inserted and the turnbuckles tightened until the spool clears the ground. The spool is positioned at a point convenient to the deadline anchor where a minimum amount of work is required to pull over additional new line.

When the rig is moved, the arms and turnbuckles may easily be removed merely by slipping out the bolts attaching them to the columns. If preferred, the hangers may be swung up close to the columns and lashed in place with soft rope while the rig is being moved. The speed with which the spool can be rigged up ready for use by only one or two men, and the small amount of material required to construct it contribute to the desirability of this type of support. Elimination of the possibility of the spool falling over on a man's foot or "getting away" when new line is pulled over, are valuable safety factors.



Tubular goods inspection apparatus is transported in this light, compact trailer unit.

# New Technique for Tubular Goods Inspection

By FRED HUHN
Vice President, Western Inspection Company

MAGNETIC inspection of pipe has become widely accepted in the industry's ceaseless search for perfect performance under severe conditions. Drill pipe, casing, tubing and hollow sucker rods must all undergo constant, tremendous strains.

Granted that the manner in which this pipe is produced and the price at which it is sold make it impossible to have every joint flawless, the industry still must demand greater perfection as wells grow deeper and pressures mount.

Because the magnetic inspection method has been so widely accepted throughout all industries as a dependable technique for detecting flaws in ferrous materials, several articles have been published on the subject. To avoid repetition, only a brief description of the magnetic inspection method will be presented.

In magnetizing materials for the purpose of inspection, the work is actually transformed into a magnet. Any break of the continuity in the metal, no matter how minute, has the effect as if the magnet were broken in half, thereby creating opposite poles. The action of these opposite poles is comparable to that of the two ends of a horseshoe magnet and any flaw, even if invisible, when dusted with iron powder, will attract these iron particles so that the flaw is com-

• CONTINUED ON PAGE 122

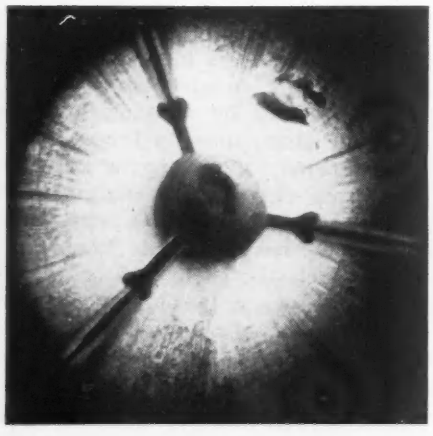
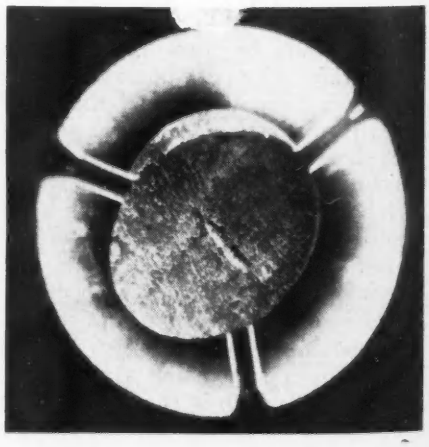


Illustration of inclusion present in 2½-inch tubing. Presence of the inclusion pocket left only 15 percent of the tubing wall thickness.



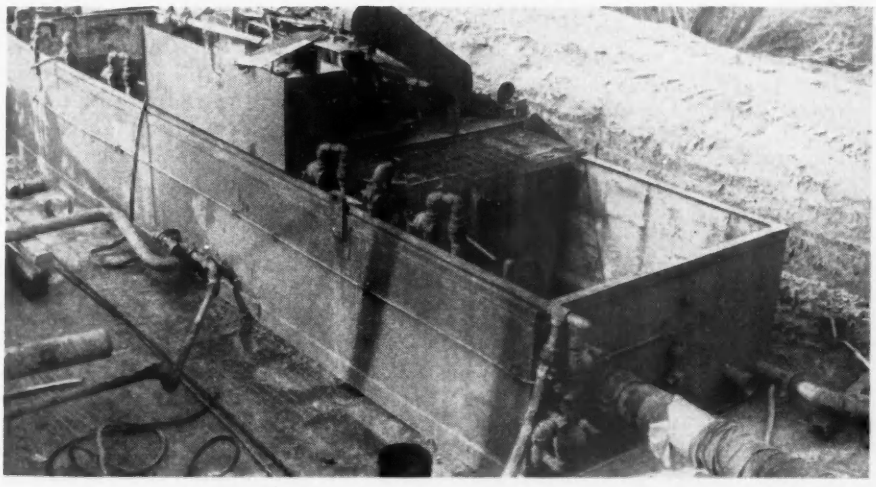
Magnified internal view of minute fatigue crack in 4½-inch drill pipe. Note iron powder build-up outlining cracks otherwise invisible.

# Unitizing a Mud Tank

By JOHN C. ALBRIGHT
Consultant, Santa Monica, Calif.

PIONEER Drilling Company, currently operating in the Richfield Oil field, Placentia, Calif., uses a mud tank which was designed to contain everything necessary for handling drilling muds. Dimensions are such that the unit can be hauled anywhere on the average flat-bed truck and trailer within highway regulations.

After the size was computed, the box was built entirely of steel and reinforcing angle iron. The next consideration was for the inside compartments. Since the design called for three separate bins, the largest compartment was placed at one end, and occupies approximately one-half the entire box. The other half was divided into compartments for mixing muds, located at the opposite end, and the middle compartment with dividing walls to receive mud passing through the shaker screens. Control valves in both walls of this compartment permit diversion of drilling mud to either end as desired.



Unitized mud tank of Pioneer Drilling Co., in which the discharge hydraulic line is placed so all service piping may be attached to it without using a separate distribution manifold.

Circulation section of Pioneer's unitized mud tank showing suction and discharge fittings. The use of couplings on suction and lug-type unions on discharge provide makeup facilities requiring little time.

It was decided to build into this mud tank as much of the necessary piping as practicable to eliminate outside lines to the fullest extent. The usual hydraulic transfer line from the pumps to the derrick standpipe was built into the mud tank to extend from one end to the other with fittings on both ends for pump discharge connections. Normal drilling operations on which this rig is applied require the use of only the main circulating pump, leaving the other one as a reserve unit to mix special batches of mud in the corresponding end of the mud tank. The discharge header inside the tank is fitted with an outlet nipple to which the standpipe lead is connected. Opposite this fitting is another take-off which leads to the other side of the tank for dumping mud from the compartments when cleaning the tank. From this line, a distribution pipe extends the full length of the unit for attaching mud guns and service lines for agitation and to maintain constant fluidity.

The hydraulic line take-off from the mud tank to the derrick standpipe is a standard length to permit a space of six feet between the tank and the derrick substructure so that rigging up from well to well can follow a consistent pattern. Therefore, each piece of pipe and each length of hose fits into its required position without cutting, threading or make-up of odd length nipples. This method presumes full cooperation between lessee and contractor so that all measurements of distances between the shale pit and the locations are kept standard. If the shale pit is at a greater distance than the design, more time is obviously required for rigging up due to making extra connections.

When rigging up, the mud tank is unloaded in the desired position so the shaker apron extends over the edge of the shale pit. Timber mats are laid as foundations for the pumps, which are then jacked into their rela-

tive position. Using standard hose for suction, one end is attached to the pump suction with conventional bolted flanges. The tank end is attached to the suction pipe with a coupling which permits considerable deflection so that precise alignment is not required. Discharge from the pump is carried through hydraulic hose, long enough to compensate for any difference in distance or position of the pump from the mud tank fittings. A discharge manifold on each pump is designed so mud can be discharged from either side so that either pump can be set for circulation or for mixing the mud. The suction fittings on each end of the tank are identical and have goosenecks extending downward to the floor of the compartment to eliminate a layer of inactive mud or a buildup of sediment. The compartment for mud mixing contains two discharge fittings, one for recirculation of the fluid while the mix is being prepared, and the other located so this pump can be changed quickly to an auxiliary drilling pump.

Power wiring is attached permanently in conduit to the sides of the mud tank with approved outlets for inserting lighting fixtures. The lead to the shaker is permanently attached but can be disconnected from the motor when this unit is to be removed. When tearing down the rig, the mud tanks are pumped dry into the shale pit and the easily broken-out fittings removed from suction and discharge. Heavy lugs welded to the sides of the tank at four points provide means of hooking a motor crane hoisting bridle for loading on a truck. With these improvements and standard fittings, two men can make necessary connections from pumps to mud tank, and hook up the hydraulic line leading to the derrick standpipe in less than two hours without rushing the job.

**Mud preparation end of tank where similar connections are used, and piping from pump discharge to standpipe extends through tank from end to end so that both pumps can be used when necessary.**

## *Tubular Goods Inspection*

■ CONTINUED FROM PAGE 120

pletely outlined to its fullest extent.

With the new methods of applying or dusting the entire length of the pipe internally and externally with iron powder, the occurrence of error is reduced to a minimum. Optical equipment for viewing the internal surface of pipe has also been greatly improved by the development of a better lense system, making it possible to view any one point in the pipe at a magnification of five diameters.

Drill pipe inspection is done in several operations. To check wear on the outside diameters of the pipe, a continuous reading gauge is used. Any pipe worn eccentrically or with wall thickness reduced more than the tolerance established for certain types of drilling or locations is declared unfit for further service. Tool joints, threads and shoulders are inspected for excessive wear.

### Inside Cleaning

The inside surface of the pipe is cleaned by means of a stiff wire brush in conjunction with a blast of air. In some localities sand blasting is employed to remove chert or very hard deposits. The pipe is then magnetized and dusted with iron powder the entire length, inside and out. External inspection is done at the time the iron powder is applied. The internal dusting is done with a special device which operates similar to a spray gun. The total inside surface is then minutely inspected with the optical equipment mentioned above. For an inspector to make a comprehensive report, each joint in the string is numbered. Any flaw on either the inside or outside of the pipe is photographed.

To have a good string of casing or tubing, it is essential that each joint be free of defects and threaded members in the best possible condition to avoid leaks. Good mating threads and the proper thread lubricant will, of course, avoid leaks. However, threads may easily be damaged in transportation and handling, and it is therefore considered good practice to visually inspect them before final installation, especially since damaged threads are rather easily spotted. If a string of casing or tubing has been stored in the open for a long period, temperature changes and weathering will dry out the thread dope. Several major operators have found it best to remove all the couplings, clean all threads, and apply fresh thread lubricant.

Casing and tubing inspection follows about the same pattern as that employed in drill pipe inspection, except that a great many operators demand that their pipe be hydrostatically tested, but to use both services on the same pipe proves too costly.

### Testing Threads

Pressure testing can only find leaky couplings, or, on rare occasions, mill defects that would be readily detected by normal inspection procedure. It is quite obvious that the normal inspection procedure could not possibly find leaky couplings. To overcome this situation a new tool, which eliminates pressure testing a full joint, has been developed for the purpose of testing only the threaded portion of a tool joint. The tool packs off the interior of the pipe about six inches beyond the coupling and the open end of the coupling is packed off in its counterbore. The area between the two packoff points is taken up by the body of the tool itself, whose diameter is slightly less than the inside diameter of the pipe, allowing only a very small space for the hydraulic medium to fill. This eliminates the need of any large amount of water on location, since less than one-half pint of fluid is required for each test. The pressure is supplied by a 15,000 pounds per square inch hand pump and the complete operation is quite rapid. An actual job performed in the Rio Grande Valley on 240 joints of 2½-inch tubing, which was tested at 8200 pounds per square inch, revealed 124 leaky couplings. The leaking pressure was above 5000 psi.

The new tool has been displayed in a unique manner. A section of two-inch tubing was prepared with a 5/32-inch hole drilled through the wall immediately beyond the coupling. A piece of sheet metal, .015-inch thick, was soldered over this hole on the inside of the tubing. The piece of tubing held 8000 pounds of pressure for hundreds of demonstrations. This demonstrates the fact that pressure testing may not always reveal a mill defect of similar nature.

# A Drillability Classification Of Geological Formations

By ALBERT L. HEAD, JR.
Project Engineer, Chance-Vought Aircraft Company, Dallas

THIS paper has been written because of the need in the drilling industry for a system by which different types of bits can be classified with respect to different types of geological formations.

As background material, a discussion of the factors which affect the rate of penetration of rock bits is presented. These factors are: (1) Formation, (2) Type of Bit, (3) Weight on Bit, (4) Rotational Speed, (5) Hydraulic Action, (6) Size of Hole, and (7) Personnel and Equipment.

A classification of geological formations based entirely upon the relative efficiency with which these formations can be drilled with a small rolling-cutter type of test bit has been established. This classification is shown to be consistent with actual field drilling practices.

A method of classifying different types of actual bits with respect to the classified formations is illustrated. This method provides a means of determining a sphere of application for each type of bit; that is, the formations which each type drills most economically with respect to all the other types can be determined. This means that most of the guesswork concerning the selection of a bit for a particular formation can be eliminated.

Limited tests have been conducted to determine if there is any relationship between the drillability of a formation and the hardness. Based on the results of these tests, no relationship could be established.

### Research Essential

The oil well drilling industry is one of the most important industries in the world today. The products of this industry—gasoline, lubricating oils, natural gas, and many by-products—have virtually made possible the way of life and high standards of living of most of the peoples of the world. Without these products, much of the progress achieved in other major industries could not have been possible. Therefore, to ensure continued progress in the oil well drilling industry and other industries dependent upon oil products, research must be conducted continuously to endeavor to improve drilling practices.

A major problem confronting the drilling industry is selection of the proper type of drilling bit for any particular application. A knowledge of the relative merits of any type of bit would be exceedingly valuable to drillers and bit manufacturers alike. To provide a procedure by which these merits can be determined, "A Drillability Classification of Geological Formations" is hereby proposed.

This classification is based upon the relative efficiency with which formations can be drilled. The purpose of such a classification is to provide a scale by which different types of drilling bits can be compared with each other with respect to geological formations.

This system would eliminate much of the guesswork associated with the selection of a drilling bit for any particular formation. At this time, each driller has his own ideas, based upon his experience, concerning the selection of a particular type of bit for a particular formation. A survey of the opinions of many drillers has resulted in a general trend which classifies a bit either as a hard formation bit or a soft formation bit. Yet, there is still much latitude because there are many types of hard and soft formation bits. The establishment of a drillability classification of geological formations would be a step towards classifying bits with respect to formations they drill most economically.

**A TECHNIQUE designed to assist the operator in scientifically selecting drill bits for the penetration of known formations is explained in this article. A reverse to the usually accepted method, the procedure involves an exacting classification of formations as the criterion for engineered bit programs. The paper was presented at the Third World Petroleum Congress and represents the resume of a thesis submitted to The Rice Institute in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering.**

Since the efficiency with which a formation can be drilled is manifested by the rate of penetration of the drilling bit in the formation, a study of the factors which affect the rate of penetration is in order. Many investigators have heretofore studied and analyzed these factors. The objective of this investigation will not be to duplicate those reports, but to summarize their findings as a preliminary to establishing a drillability classification.

The importance of the rate of penetration has long been recognized by the oil well drilling industry. The cost of actually drilling a well is approximately 75-percent of the total cost of the well[1]; moreover, most of the drilling costs are dependent on the time element. Any method of increasing the rate of penetration, therefore, will reduce the time element and decrease the cost of drilling. A thorough understanding of the factors which affect the rate of penetration is essential before methods of increasing this rate can be developed. These factors are:

- Formation
- Type of Bit
- Weight on Bit
- Rotational Speed
- Hydraulic Action
- Size of Hole
- Efficiency of Personnel and Equipment

*Formation:* The geological formation encountered is the only factor truly independent of control. Some of the more common formations drilled are shale, sticky shale, salt, plastic clay, sandy shale, soft sand, sand, gravel, hard sand, sandstone, limestone, hard limestone, dolomite and granite. Each formation has characteristics which affect its resistance to

penetration; hence, the disposition of the remaining factors must be of such a manner to produce the maximum economical rate of penetration.

*Type of Bit:* The rock bit is the instrument which transmits energy to the formation being drilled. Since the rate of penetration is necessarily dependent on the amount of energy applied and the manner of application, the importance of efficient energy transmittal cannot be ignored. A theoretical and scientific investigation of the rock bit design problem is virtually an impossibility because of the numerous unknown variables; so, the design of rock bits has been based upon empirical considerations which seem to indicate increased penetration rates.

The cutting elements of rock bits are of two general forms, one cylindrical and the other conical. On these cutting elements are formed teeth of various designs. The angle formed between the intersection of the cutter axis and a plane containing the longitudinal axis of a tooth varies from 0 to 90 degrees. As the cutter rotates each tooth successively strikes the formation, delivering sharp impacts. In hard, brittle formations high compressive stresses are induced around each point of impact. If these induced stresses exceed the ultimate crushing strength, the formation will be removed by a chipping action similar to that of a sculptors' chisel. In relatively soft formations the teeth will embed themselves as the cutter roembed themselves as the cutter rotates, producing wedging actions which pry the formation loose.

Rock bit manufacturers have constantly endeavored to improve their bits; however, the fundamental design of bits has changed very little. Metallurgical advancements are responsible for most bit improvements. Superior alloys have been developed; heat treatment techniques have been perfected; and areas subject to severe abrasion have been dressed with tungsten carbide. The general tendency concerning the tooth pattern on cutters is to have shallow, closely spaced teeth for hard formations and deep, widely spaced teeth for soft formations. There are innumerable tooth patterns manufactured which display no better cutting performance than some slightly different pattern, the difference being only a matter of opinion.

Concerning the bit, more study should be applied to the actual cutting elements to effectuate increased penetration rates. These cutting elements need to be designed to facilitate the removal of the cuttings by the drilling fluid more effectively.

*Weight on Bit:* The weight applied on the bit has been found to have a most significant effect upon the rate of penetration. The fact that penetration rates increase with increased bit weights is well known; yet, the exact manner of the variation has not been conclusively determined.

Tests have been conducted to evaluate the effect of bit weight upon penetration rate. During these tests all other factors affecting the rate of penetration were kept constant. The weight was varied between 10,000 and 30,000 pounds, and the fluid circulation was sufficient to keep the bit clean at all weights. In hard, dense formations with approximate penetration rates of 5 to 12 feet per hour, the penetration rate was directly proportional to the bit weight.[2] Actually, some deviation from direct proportionality occurred; nevertheless, the relationship can be taken as an effective average value.

In medium hard, abrasive formations with approximate penetration rates of 10 to 40 feet per hour, a 100 percent increase of weight resulted in a penetration rate increase of 55 percent.[3]

In softer formations with approximate penetration rates of 50 to 90 feet per hour, a 100 percent increase of weight resulted in a penetration rate increase of 50 percent.[3-4]

Retrospectively, an increase of weight is more effective in hard formations than in soft ones; however, there is a most economical weight for any set of conditions. Other tests which consider the life of the bit indicate that the weight which produces the maximum rate of penetration is not the optimum weight to use.[5] The optimum weight for hard formation drilling is approximately 25,000 pounds for a cross cutter type bit 6¾ inches in diameter. Although this value is about half of the value which produces maximum penetration rates, the total footage drilled per bit is almost 300 percent greater than the total footage obtained when using the maximum weight. Excessive wear and unusually high stresses in the bit are produced when the weight for maximum penetration rate is applied, resulting in premature failure of the bit.

Obviously, there are upper and lower limits beyond which weight variations produce no change of penetration rates. The lower limit is the weight necessary to cause the compressive strength of the formation to be exceeded as each tooth strikes it. Unless the minimum weight is applied, the formation is merely worn away. When the minimum weight or some greater weight is applied, the formation will be chipped away. The upper limit is the weight which causes the maximum rate of penetration.

*Rotational Speed:* Of the factors

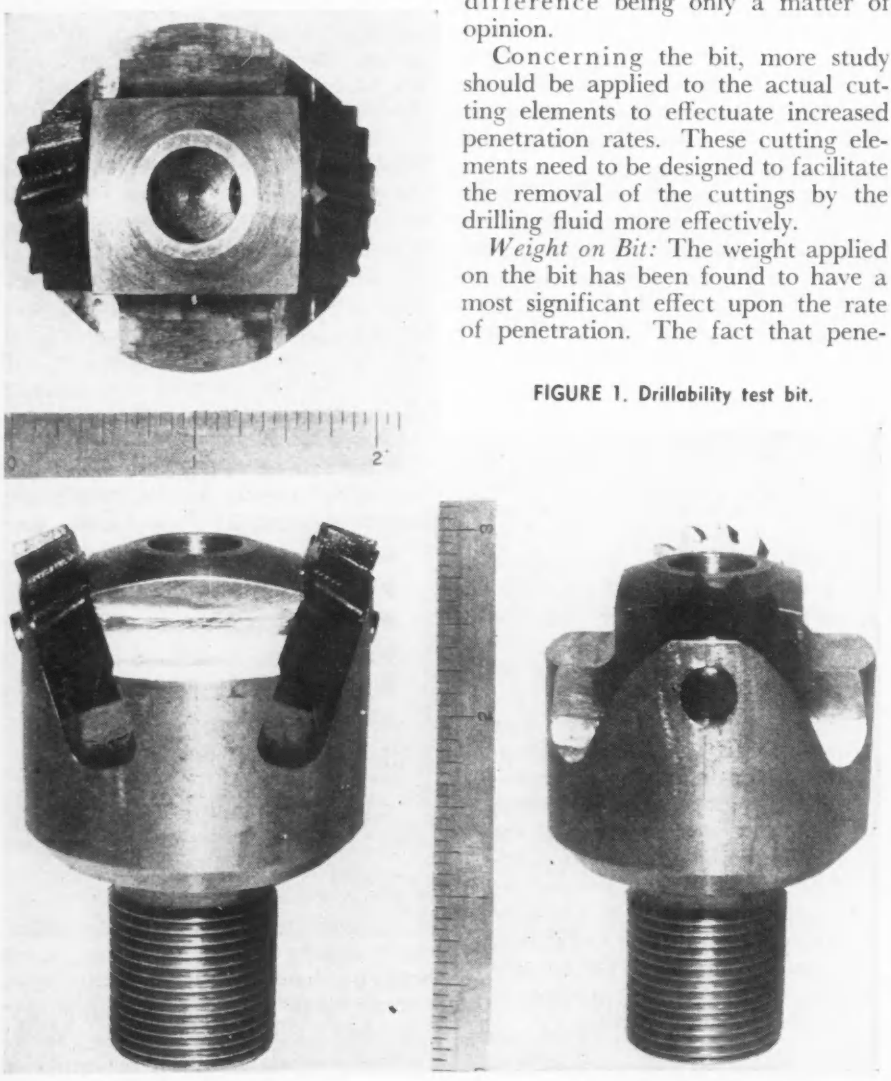


FIGURE 1. Drillability test bit.

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which affect the rate of penetration, rotational speed is probably the most controversial. Speeds of 40 to 400 revolutions per minute are in common use at this time, and speeds as high as 750 rpm have been used for experimental drilling. Selection of the rotational speed has depended primarily upon the driller's opinion, founded upon his experience, rather than upon the formation being drilled.

FIGURE 2. Diamond core bit.

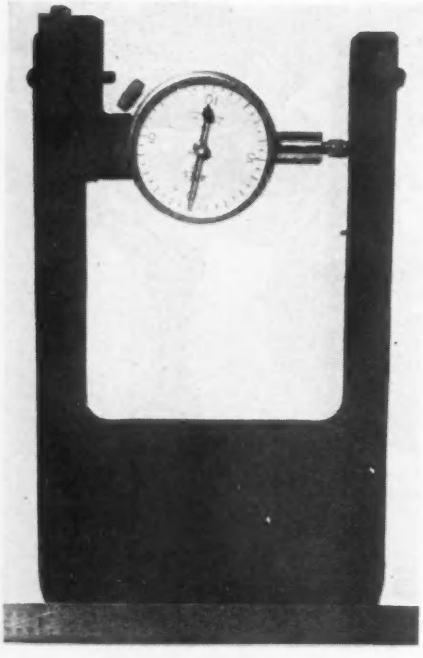

FIGURE 3. Deflection scale.

In general, other factors remaining constant, the rate of penetration increases as the rotational speed increases, assuming fluid circulation is adequate to remove the cuttings. There is an exception to this general postulation, however. Hard formations such as limestones, quartzite, anhydrite, and sandstones are best drilled using rotational speeds of 40 to 100 rpm. These formations cannot be drilled at high rotational speeds because of the physical limitations imposed by the drilling equipment. At high speeds severe vibrational conditions exist which cause premature failure of the drill pipe.

Specifically, the results of one investigation showed that over a period of 45 months the rate of penetration increased 39.6 percent because of a rotational speed increase of 33⅓ percent—75 to 100 rpm.[3] Another study, limited to bits having two cutting elements drilling Taylor shale, revealed that the rate of penetration increased 50 percent when the rotational speed increased 100 percent.[4]

The discrepant results of the investigations cited above illustrate the type of data obtainable concerning rotational speed; therefore, the knowledge of the conditions existing at the time of the investigations is essential. The first study cited reveals the very general tendency of the relationship between rate of penetration and rotational speed. The second study shows the very specific relationship obtained when using a certain type of bit on a certain formation. Both types of results are valuable, the value being in the correct interpretation.

*Hydraulic Action:* Hydraulic action may be defined as all of those drilling fluid functions affecting the rate of penetration. There are many functions of the drilling fluid in addition to those which affect the rate of penetration, but those additional functions will not be considered here. The functions of the drilling fluid which affect the rate of penetration are the rate of circulation, the nozzle-fluid velocity, and the nozzle efficiency.

Tests have been performed to evaluate the effect of the circulation rate upon the penetration rate. One such test revealed an average penetration rate increase of 28.6 percent for each 200 gallons per minute increase of circulation rate.[3] More recent tests confirm the general trend that an increase of circulation rate results in an increase of penetration rate; however, the increase of penetration rate is small compared to the increase of hydraulic horsepower necessary to effectuate the change.[4] In all instances the annular return velocity must be sufficient to remove the cuttings. A return velocity of 200 feet per minute has been used successfully by one investigator.[6]

Until recent years the nozzle-fluid velocity has been given little consideration. Experiments performed to evaluate the nozzle-fluid velocity effect have shown it to be of significance.[4] These experiments indicate that the penetration rate increases as the velocity increases, assuming the annular return velocity is sufficient to remove the cuttings. In medium hard formations the penetration rate of two-cutter jet bits changes little if velocities less than 150 feet per second are used. Between velocities of 150 and 200 feet per second, a distinct increase in the rate of penetration usually occurs; however, from this point on, the rate of increase of the rate of penetration decreases as the velocity increases.

Based on the most reliable sources

**TABLE 1**

**Test Data Used to Determine Drillability Classification Numbers. Bit Thrust, Rotational Speed, and Depth Drilled Were Held Constant at 417 Pounds, 110 Revolutions per Minute, and 1/16-inch, Respectively.**

| FORMATION | Location | Time (Min-Sec.) | Average Rate of Penetration (Ft./Hr.) | DCN[c] |
|---|---|---|---|---|
| Sandstone, Wilcox | Natchez, Miss. | 0- 2.0<br>0- 1.8 | 9.88 | 1.9 |
| Lime, Canyon Reef | Snyder, Tex. | 0- 2.0<br>0- 2.0 | 9.38 | 2.0 |
| Anhydrite | Gulf Coast Tex. | 0- 4.1<br>0- 3.1<br>0- 3.0 | 5.52 | 3.4 |
| Lime, Mississippi | Dover, Okla. | 0- 4.0<br>0- 3.9<br>0- 3.8 | 4.82 | 3.9 |
| Hard Marine Shale, Hosston | Haynesville, La. | 0- 4.7<br>0- 4.2<br>0- 4.0 | 4.37 | 4.3 |
| Crystalline Lime | Rotan, Tex. | 0-12.0<br>0-11.2 | 1.62 | 11.6 |
| Carboniferous Shale | West, Tex. | 0-16.1<br>0-14.6<br>0-14.4 | 1.25 | 15.0 |
| Hard Sandstone, First Bromide | Lindsey, Okla. | 0-21.2<br>0-17.9 | 0.957 | 19.6 |
| Sandy Limestone, Smackover | Haynesville, La. | 0-28.1<br>0-23.9 | 0.722 | 26.0 |
| Impure Limestone | Unknown | 0-34.2<br>0-29.8<br>0-26.3 | 0.623 | 30.1 |
| Sandstone | Unknown | 0-38.4<br>0-36.2 | 0.503 | 37.3 |
| Syenite | Central Tex. | 0-38.4<br>0-37.0 | 0.497 | 37.7 |
| Chert | West Tex. | 0-47.0<br>0-45.4<br>0-45.0 | 0.408 | 45.8 |
| Pink Granite | Central Tex. | 1-15.0<br>1-13.2 | 0.253 | 74.1 |
| Quartziferous Sandstone, Hosston | Bethany, Tex. | 9-39.6<br>9-11.7<br>8-55.9 | 0.034 | 555.7[d] |

[c] Drillability Classification Number.

[d] This formation was very hard, consolidated, abrasive sandstone which could not be chipped regardless of the thrust applied to bit. For this reason the DCN is exceedingly high

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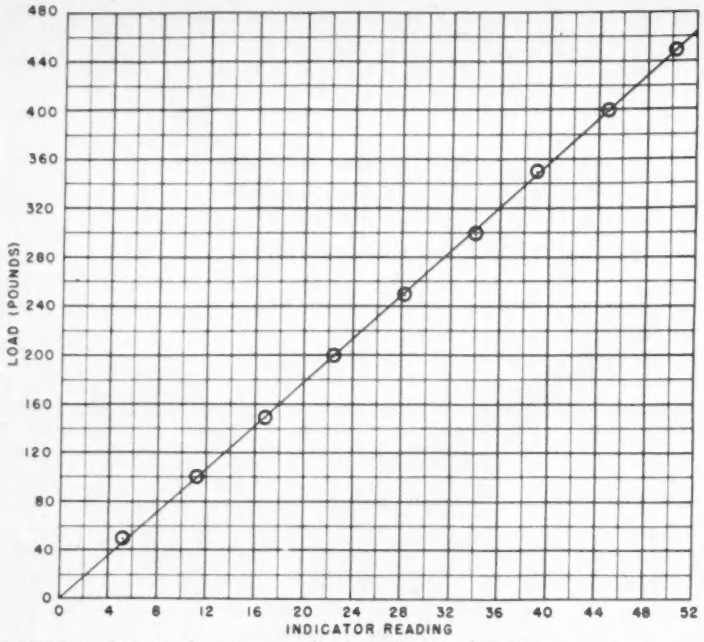


FIGURE 4. Relationship between load applied and indicator reading for deflection scale.

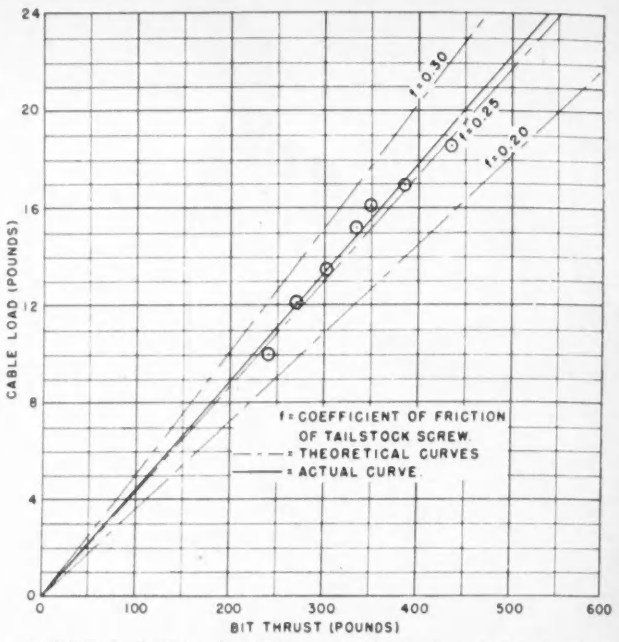


FIGURE 5. Relationship between cable load and bit thrust for drillability test apparatus.

available, the penetration rate increases as the velocity increases when all of the fluid is directed on the bottom of the hole. Too, there is a minimum nozzle-fluid velocity for each formation, below which the rate of penetration is not significantly affected by variation of the fluid velocity.

The nozzle efficiency directly affects the hydraulic horsepower necessary to maintain adequate rate of circulation and nozzle-fluid velocity. The coefficient of discharge of commonly used bit nozzles varies between 0.80 and 0.92. Therefore, the use of more efficient nozzles will make available additional horsepower for increasing the rate of penetration. For example, a change in the nozzle coefficient of discharge from 0.80 to 0.99 will reduce the pressure drop and horsepower loss at the nozzle approximately 35 percent.[4]

*Size of Hole:* Differences of opinion exist concerning the proper size hole to drill. Comparison of rates of penetration obtained with different size bits shows no definite trend. The rate of penetration should theoretically increase as the hole diameter is reduced, but this does not always happen. Smaller size bits must be run with lighter loads than larger size bits; the net result, in many cases, is penetration rates that are about equal. Consequently, the selection of the hole size is usually based upon economic considerations.

*Efficiency of personnel and equipment:* Certainly, the efficiency of personnel and equipment has the greatest effect upon the rate of penetration of rock bits. An investigation extending over a three-year period shows that the rate of penetration increased 55.5 percent as a result of increased efficiency of personnel and equipment.

The effect of personnel efficiency has been illustrated further as a result of the recent war. During the period of 1942 to 1944 there was an actual decline in the rate of penetration.[7] Apparently, the only change to cause this decline was the loss of experienced personnel to the armed services. These men were replaced by men with less experience, resulting in decreased drilling efficiency.

### Establishment of Drillability Classification

As evidenced by the preceding discussion, there are many factors which affect the rate of penetration of a bit. Also, general agreement exists among most drillers and manufacturers concerning the manner in which these factors tend to affect the rate of penetration. The aim of all the former investigators has been to devise means of making oil well drilling more economical by increasing the rate of penetration; however, the majority of these investigators have presupposed that the proper type of drilling bit was being used in the particular formation being drilled.

A so-called hard formation bit was employed in a hard formation, to be sure; but since many types of hard formation bits exist, perhaps a slightly different type of bit would have performed better. Very little, if any research has been done to establish as closely as possible a definite sphere of application for each type of bit. Consequently, many types of bits probably have overlapping spheres of application; indeed, they may have coincident spheres of application. Thus, the need for a system whereby different types of bits are classified in a relative manner with respect to formations drilled is of great importance.

One method of classifying bits with respect to formations drilled would be to systematically test each type of bit in every formation. By varying the remaining factors which affect the rate of penetration, each type would be found to drill in some one formation more economically than in all the other formations. Obviously, such a system of classifying bits would be impractical, if not impossible, because of the tremendous financial costs that would be required.

As a means to an end, another method of classifying bits would be first to classify the formations with respect to each other and then classify the different types of bits with respect to the classified formations. A drillability classification of geological formations would adequately classify the various formations with respect to each other. Once a drillability classification has been established, each type of bit can be graded in accordance with its performance in each formation—the performance of each bit being determined by observation of actual field and experimental drilling data over a long period of time. In each formation there will be one type which will distinguish itself above all the others. If two or more bits perform equally well, they have overlapping spheres of application; and one of them should be eliminated. Hence, a schedule of bits showing

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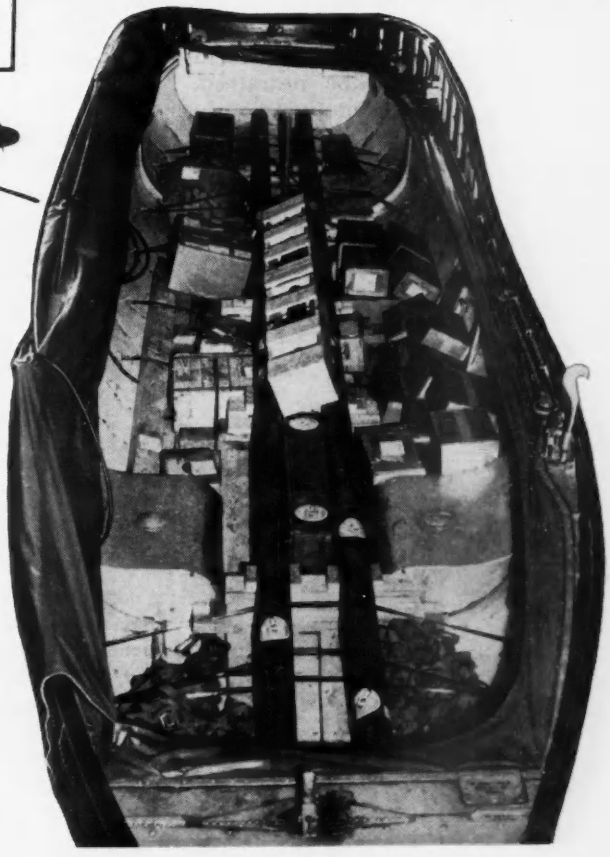

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which formations they drill best can be prepared. The classification will be limited to formations commonly referred to as hard formations which are drilled with a rolling-cutter type bit.

A method of classifying different types of bits with respect to the classified formations will be illustrated; however, the problem of actually classifying different bits will be left for a future study.

*Apparatus:* To determine a drillability classification, a small test bit of the rolling-cutter type was made, as shown in Figure 1. This test bit was designed to facilitate the replacement of the cutters after each drillability test. The diameter that the test bit drills was made small enough to enable the bit to drill in core samples of common sizes. Also, the bit will not drill the center of the hole, eliminating the inefficient cutting action which occurs there. A small diamond core bit has been made, as shown in Figure 2, to drill out the center portion of the hole prior to drillability tests made with the test bit.

By means of a threaded connection, the test bit was secured to the spindle of an adapter which in turn was mounted in the tailstock of a lathe—the formation samples being held in the chuck of the lathe. The spindle of the adapter was designed so that it would rotate freely. Thrust bearings were installed to absorb axial loads applied to the spindle. Directly behind the threaded connection on the spindle was attached a six-inch lever arm by which rotational movement of the spindle could be restrained. The torque applied to the spindle can be determined by measurement of the force on the six-inch lever arm necessary to restrain the rotation of the spindle. Axial force was applied to the bit by turning the tailstock screw. In order to exert a constant axial force on the bit, a constant torque must be applied to the tailstock screw. To do this, a small drum was made to replace the hand wheel which turns the tailstock screw. A small wire cable was wound on the drum and threaded through a pulley located above the drum. To the free end of the cable was attached a container for holding weights. For any weight placed in the container, a constant force is exerted by the bit. A deflection scale was made, as shown in Figure 3, to take direct measurements of the force exerted by the bit. The calibration curve for the deflection scale is shown in Figure 4. Knowing the physical characteristics of the tailstock screw and the drum, theoretical curves of cable load versus axial thrust of the bit were drawn for three different values of coefficient of friction for the tailstock screw. Then, by use of the deflection scale, the drillability test setup was actually calibrated. The results were plotted on the same coordinates as the theoretical curves, and they are all shown in Figure 5.

The axial movement of the bit can be accurately determined by noting the length of cable wound off the drum. The physical characteristics of the tailstock screw and drum magnify the axial movement of the bit approximately 125 to 1; for example, if the cable unwinds one-eighth inch, the bit moves axially $^1/_{1000}$ inch.

With the apparatus described above, as shown assembled in Figure 6, measurements of rotational speed, force exerted by the bit, torque, depth drilled by the bit, and time necessary to drill depth can be taken.

*Test Procedure:* Before tests were made to establish a drillability classification, preliminary tests were made to determine whether or not the performance of the test bit would be analogous to the performance of actual rock bits. The test bit was run in a core sample of West Texas chert. The rate of penetration was determined for different values of bit thrust while the rotational speed remained constant. The results of these tests are shown plotted in Figure 7. The rate of penetration was found to be directly proportional to the bit thrust for a given speed. Other investigators have also found the rate of penetration to be directly proportional to the weight applied to actual rock bits.[2,3,4] Therefore, the performance of the test bit is similar to the performance of actual rock bits.

To establish a drillability classification with the described test apparatus, the core sample was mounted in the chuck of the lathe; the center was drilled out with the diamond core bit; and the test bit was then run on the sample. Figures 8 and 9 represent pictorially these operations. The major problem encountered was that of deciding what factors to compare to establish a relative classification of the formations. If a series of tests were made in each formation sample similar to the tests made in the West Texas chert, shown in Figure 7, the problem of what to compare would still exist. The family of curves obtained would be shifted one way or the other along the rate of penetration axis. Nothing specifically could be compared.

The work required to drill a certain depth in each formation sample could be determined by taking measurements of torque and time. However, upon taking torque measurements for several formations at different conditions of rotational speed and bit thrust, accurate measurements

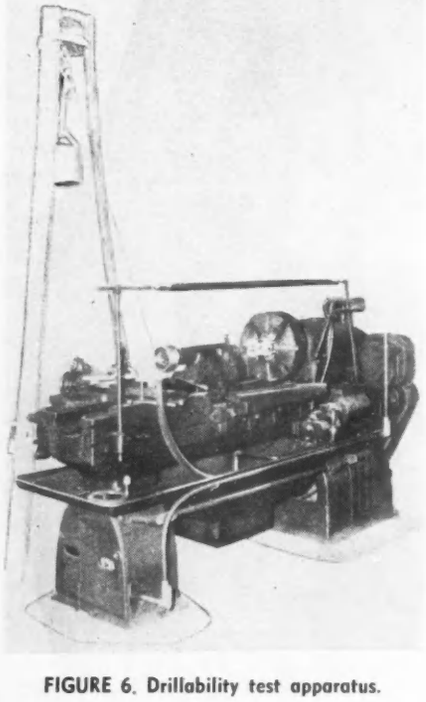

FIGURE 6. Drillability test apparatus.

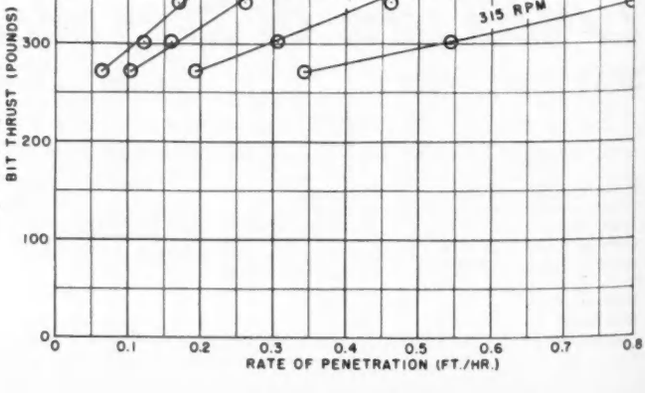


FIGURE 7.

Relationship between bit thrust and rate of penetration for drillability test bit in West Texas chert.

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were impossible to obtain because of vibrational conditions inherent for this type of test. Also, on the basis of torque measurements obtained, the range was not sufficiently broad between formations relatively easy to drill and formations relatively hard to drill.

The factors which could be measured most accurately were rotational speed, bit thrust, depth drilled, and time. Since the time to drill a given depth determines the rate of penetration and the total amount of work expended drilling this depth, the rate of penetration necessarily reflects the work expended on the formation being drilled. Hence, the decision was made to use the time interval necessary to drill an equal depth in each formation—rotational speed and bit thrust remaining equal for each test—as a basis for comparison to determine a drillability classification of geological formations.

By making further tests on formations relatively hard to drill and formations relatively easy to drill, a depth of $^1/_{16}$ inch was selected as the depth to be used for the drillability classification tests. This depth was not arbitrarily chosen. A wide range of time values was found, and the wear on the cutters of the test bit was negligible.

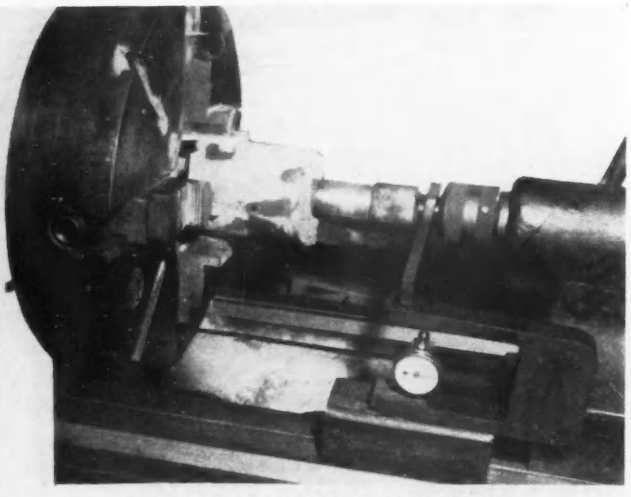
In conjunction with selection of the depth to be drilled, the speed and bit thrust had to be chosen. A rotational speed of 110 rpm was used. This was a convenient speed on the lathe, the nearest other speeds being 60 and 188 rpm. Also, at 110 rpm, the drilling action of the bit was most uniform over the range of formations to be drilled. A bit thrust sufficient to produce chipping action on all formations was necessary. For this thrust, a value of 417 pounds was sufficient; that is, in each formation the bit thrust would be beyond the point at which chipping action begins. This value was determined actually by trial and error. With the depth and rotational speed being fixed at the above values, this value of bit thrust was selected on the basis of time values and chipping action obtainable over the range of formations to be drilled.

Thus, to determine a drillability classification, the time intervals necessary to drill $^1/_{16}$ inch in each formation were compared, the rotational speed of 110 rpm and the bit thrust of 417 pounds remaining constant. These time intervals measured in seconds were called the Drillability Classification Numbers of the formations tested.

TEST RESULTS: The drillability test bit was run in 15 formations commonly encountered in drilling. Each formation was tested as described. The Drillability Classification Number established for each formation is the average result of at least two tests. In several instances, it is the average result of three tests. The results of all the test are shown in Table 1.

To determine whether or not this classification is consistent with results

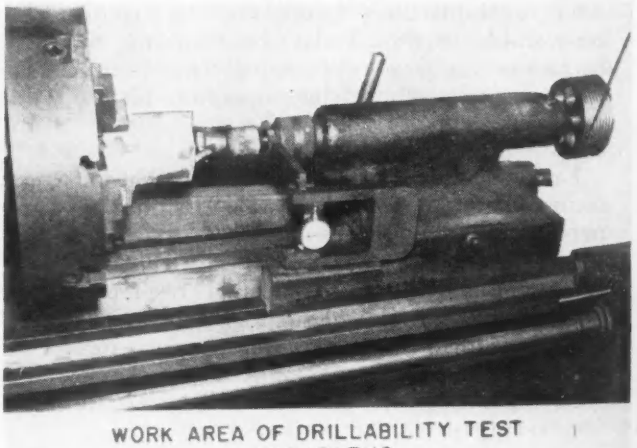
FIGURE 8.



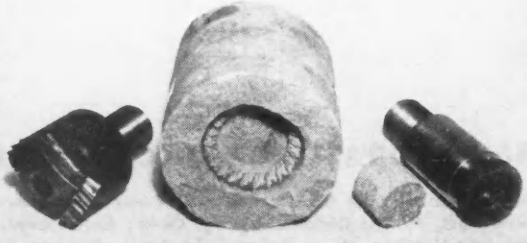
DIAMOND CORE BIT IN OPERATION.
"A"

DRILLABILITY TEST BIT IN OPERATION.
"B"

FIGURE 9.



WORK AREA OF DRILLABILITY TEST APPARATUS.
"A"



FORMATION SAMPLE AFTER BEING DRILLED.
"B"

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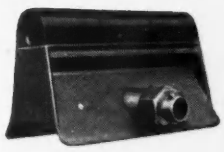

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obtained from actual bits drilling these same formations under field conditions, the performance of seven different types of bits used to actually drill several of the tested formations was examined. These bits will be designated as Bit "A," Bit "B," Bit "C", etc. Since the Drillability Classification Number is the time interval required to drill a certain depth, it is equal to the inverse of the rate of penetration if the units are consistent. In any case, the Drillability Classification Number is inversely proportional to the corresponding rate of penetration of the test bit. Therefore, if the rates of penetration of the actual bits drilling the tested formations under field conditions fall in the same order as the corresponding rates of penetration of the test bit, the drillability classification established will be consistent with actual field drilling practices. A comparison of the rates of penetration of the actual bits with the rates of penetration of the test bit is shown in Table 2.

The results obtained indicate that the drillability classification established is consistent with actual drilling practices. With the formations arranged in the order of their drillability, the rates of penetration of the actual bits fall in the same order as the rates of penetration of the test bit. This does not mean that there is a direct relationship between the rate of penetration of an actual bit and the rate of penetration of the test bit. It merely shows further that the performance of actual bits normally used to drill the tested formations is analogous to the performance of the test bit. On the basis of these tests, any rolling-cutter type of bit should drill all formations for which a Drillability Classification Number has been established in the same succession as the test bit, if chipping action occurs.

To classify different types of bits with respect to formations, an expanded table similar to Table 2 could be employed. After compiling rate of penetration data for many types of bits over a long period of time, one type of bit would be found to drill formations which have a certain Drillability Classification Number range more efficiently than any of the other types. This range would be the sphere of application for that type of bit. If a bit manufacturer had more than one type of bit which drilled the same range equally efficiently, then all but one of the types should be eliminated, effecting a saving for the manufacturer. In a similar manner, a manufacturer could obtain a better comparison of his bits with competitors' bits.

As an example of the concepts presented above, consider Table 2. The Drillability Classification Number range of 1.9 to 3.4 would be most efficiently drilled by Bit "E", the range of 3.9 to 15.0 by Bit "C", the range of 19.6 to 26.0 by Bit "F", and the range of 45.8 to 555.7 by Bit "C". It is of interest to note that Bit "C" drills two ranges most efficiently. The only explanation that can be given for this is that certain features of the design of the bit in combination with certain formation characteristics must produce this dual classification. This is an example of the type of information bit manufacturers can analyze to improve bit designs.

As another example, consider Bits "A" and "B". Bit "B" has a slight advantage over Bit "A" in most instances. Although Bit "A" and Bit "B" are competitive bits, neither should be used because other types of bits drill the entire range more efficiently than either of them; therefore, on the basis of these tests, Bit "A" and Bit "B" should be eliminated. Also, Bits "D" and "G" should be eliminated for the same reason.

A reciprocal use of the table would be to determine which type of bit to use for a formation as yet unclassified. Drillability tests could be made on a core sample of the formation and a Drillability Classification Number determined. On the basis of the number alone, a bit could be selected which drills that formation most efficiently. This type of information would be particularly valuable in drilling wildcats.

Now, the question will be raised concerning whether or not the rate of penetration data for actual bits presented in Table 2 represent the optimum rates for these bits. Reliable data of this nature are very difficult to obtain. The data presented in Table 2 were compiled over a period of approximately one year. Every entry represents the average rate of penetration of at least two bits drilling in the particular formation indicated. The diameter of these bits varied between 7⅞ and 9 inches; bit weight between 30,000 and 35,000 pounds; rotational speed between 50 and 60 rpm; mud weight between 9.5 and 12.5 pounds per gallon, and mud pressure between 800 and 1100 psi. All these values are in accordance with accepted drilling practices which tend to produce the most economical rates of penetration rather than the maximum rates. As previously discussed under Weight on Bit, the maximum rate of penetration of a bit is not the most economical rate.

### Geological Formation Hardness

An attempt was made to determine the relationship between the hardness and the drillability of formations. Several specimens of different formations were mounted in bakelite and polished. On each specimen microhardness tests were made, as shown in Figure 10, using a Knoop Indenter. The Knoop hardness of each specimen was determined by averaging ten readings. These hardness values were compared with the Drillability Classification Numbers of the formations, as shown in Table 3.

On the basis of these tests, no relationship exists between the hardness and drillability of the tested formations. Very hard crystals are present in nearly all formations. These crystals are in many instances harder than steel quenched and tempered to

**TABLE 2**

**Comparison of the Rates of Penetration of Actual Bits with the Rates of Penetration of the Test Bit.**

| FORMATION | DCN* | Rate of Penetration of Test Bit (Ft./Hr.) | RATE OF PENETRATION OF ACTUAL BITS (Ft./Hr.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Bit "A" | Bit "B" | Bit "C" | Bit "D" | Bit "E" | Bit "F" | Bit "G" |
| Sandstone, Wilcox | 1.9 | 9.88 | .... | .... | .... | .... | 35.0 | .... | 33.0 |
| Lime, Canyon Reef | 2.0 | 9.38 | 13.5 | 13.8 | 17.1 | 14.8 | 21.0 | .... | 20.0 |
| Anhydrite | 3.4 | 5.52 | 7.0 | 7.5 | 8.5 | 7.8 | 10.0 | .... | 10.0 |
| Lime, Mississippi | 3.9 | 4.82 | 4.7 | 4.9 | 5.4 | 5.2 | 4.2 | 4.6 | 4.0 |
| Hard Marine Shale, Hosston | 4.3 | 4.37 | 4.1 | 4.0 | 5.0 | 5.0 | .... | 4.2 | .... |
| Crystalline Lime | 11.6 | 1.62 | 3.6 | 3.8 | 4.2 | 4.1 | .... | 3.4 | .... |
| Carboniferous Shale | 15.0 | 1.25 | 3.5 | 3.7 | 4.0 | 3.9 | .... | 3.2 | .... |
| Hard Sandstone, First Bromide | 19.6 | 0.957 | 2.6 | 2.7 | 2.8 | 3.0 | .... | 3.0 | .... |
| Sandy Limestone, Smackover | 28.0 | 0.722 | 2.5 | 2.5 | 2.6 | 2.5 | .... | 2.7 | .... |
| Chert | 45.8 | 0.408 | 2.0 | 2.0 | 2.1 | .... | .... | 2.0 | .... |
| Pink Granite | 74.1 | 0.253 | 1.5 | 1.8 | 2.0 | .... | .... | 1.6 | .... |
| Quartziferous Sandstone, Hosston | 555.7 | 0.034 | 0.9 | 1.2 | 1.2 | .... | .... | 1.0 | .... |

* Drillability Classification Number.

**TABLE 3**

**Comparison of the Drillability of Formations With Their Hardness**

| FORMATION | Drillability Classification Number | Knoop Hardness |
|---|---|---|
| Sandstone, Wilcox | 1.9 | 813 |
| Lime, Canyon Reef | 2.0 | 630 |
| Anhydrite | 3.4 | 127 |
| Hard Marine Shale, Hosston | 4.3 | 176 |
| Sandstone | 37.3 | 988 |
| Chert | 45.8 | 745 |
| Quartzitic Sandstone, Hosston | 555.7 | 1118 |

# "These wire rope figures really opened our eyes!"

"Couple of years ago, the boss asked me to start checking our wire rope costs. He wanted a little system of records that would tell us what each rope was doing, and how much work we were actually getting from it. Figured we could learn the brand that would last the longest—and cost the least—on our type of work.

"So I started keeping track. In our case, the jobs involving rope boiled down to a matter of tonnages moved. Wasn't at all hard to record what each rope accounted for in its lifetime. When I'd been checking long enough for the figures to have some meaning, I showed 'em to the boss. By then I could tell which make of rope was doing the best job for us, costwise and every way. The figures really opened our eyes!"

These men weren't the first to learn the value of checking rope performance. Many users of Bethlehem wire rope follow the practice regularly. We're always glad to see it, for it enables actual comparisons between brands . . . and we know that in any such comparisons, Bethlehem rope will stand out from the crowd.

Here's a fair suggestion: over a period of time, stack the Bethlehem product against any other brands of your choice. Keep tabs on them all, and at intervals study your figures. Our guess is, those records of yours will prove beyond question the solid economy—the long-term economy—of Bethlehem wire rope.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

*Export Distributor:* Bethlehem Steel Export Corporation

## LET YOUR RECORDS TELL YOU!

a hardness of 60 on the Rockwell "C" scale. (A hardness of 60 on the Rockwell "C" scale corresponds roughly to a Knoop hardness of 700.) The drillability of formations seems to be more related to the manner by which the hard crystals are bound together than to the hardness. No attempt has been made at this time to investigate the manner by which the hard crystals are bound together.

### Summary and Conclusions

Within the scope of this paper, based on tests performed with a small rolling-cutter bit, the following has been accomplished:

1. Fifteen representative hard formations have been classified according to the efficiency with which they can be drilled. Many more formations could be classified in the same manner.

2. This drillability classification has been shown to be consistent with actual drilling practices if chipping action occurs.

3. A method of classifying different types of bits with respect to the drillability classification has been illustrated. By classifying different types in this manner, a sphere of application for each can be determined. This method of measuring bit performance would reveal bits which have overlapping or coincident spheres of application, and provide a means of removing much of the guesswork associated with the selection of a bit.

4. No relationship between the hardness and the drillability of formations could be established. Extremely hard crystals were found in most formations—crystals which are in most instances harder than steel. The drillability seems to be more related to the manner by which the hard crystals are bound together than to the hardness.

In conclusion, the author believes that the results obtained from this investigation are sufficient justification for further study along these lines. The ultimate objective of any further study would be to actually classify all types of bits with respect to a drillability classification, as illustrated herein. More formations need to be classified to fill in the gaps in Table 2 and to expand the table to cover a wider range. In particular, a drillability classification needs to be established for formations relatively easier to drill than the ones considered in this thesis. To do this, the method of holding the formation samples will have to be different from the method used in this investigation. One possibility would be to mount the core sample in a plastic which sets at room temperature and atmospheric pressure. It could then be held in the chuck of the lathe. To drill in the less consolidated samples, the bit thrust would have to be less than the thrust used in this study. This suggests that several different classifications should be established, each based on a different bit thrust. These classifications would be analogous to the Rockwell "A," "B," and "C" scales of hardness. They would overlap, but each would cover a different drillability range. With these drillability classifications, all rolling-cutter types of bits could eventually be classified, providing a definite criterion by which a bit could be selected for any formation.

## About the Author

ALBERT L. HEAD, JR., project engineer for Chance-Vought Aircraft Company, received his B.S. and M.S. degrees in mechanical engineering from The Rice Institute. Commissioned an Ensign—U. S. Navy in 1942, Head was assigned duty in the Southwest Pacific theatre until 1945 when he became a reservist with the commission of Lieutenant (j.g.). He was with Reed Roller Bit Company as an engineer from 1947, except for a brief leave to complete his work at Rice, until June, 1951. Head is a registered professional engineer in Texas.

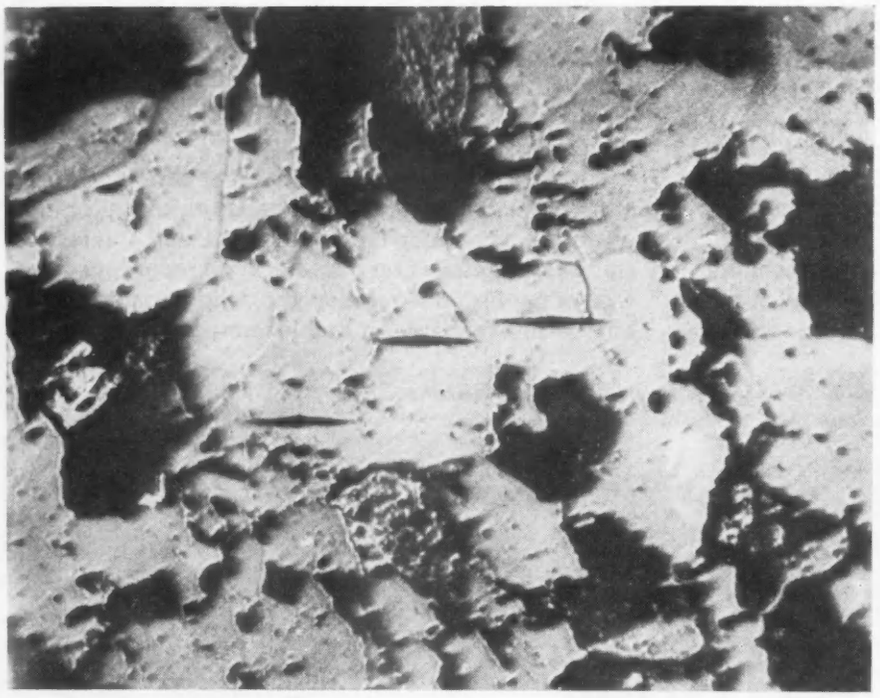

**FIGURE 10. Photomicrograph (250 X) of a polished specimen of hard sandstone from the first bromides of the Lindsay, Oklahoma, field showing indentations made by a Knoop indenter.**


#### ACKNOWLEDGMENTS

The author takes pleasure in acknowledging his indebtedness to the management of Reed Roller Bit Company for the cooperation which has made possible this investigation. All the research performed herein was conducted at the company in conjunction with a company research project performed by the author.

Thanks are also extended to Benjamine T. Simmons, geologist, Houston, for his assistance in identifying the formation samples, and to Dr. Robert Plunkett, professor of mechanical engineering, The Rice Institute, for his valuable suggestions during the course of this investigation.


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# Baash-Ross News

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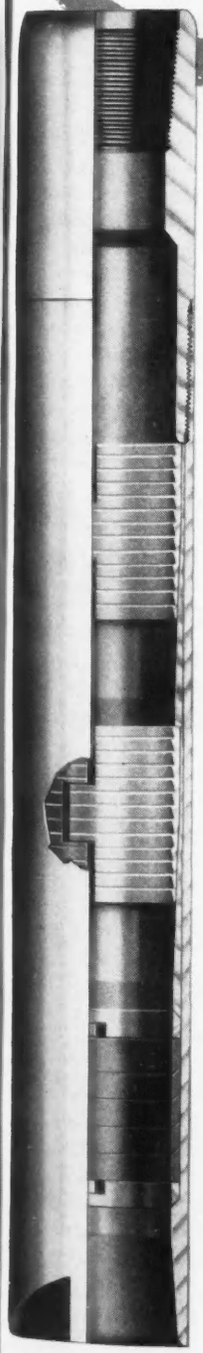
OUR 32nd YEAR

Here's the tool for SIMPLE-POSITIVE-LEAKPROOF casing repairs

★ PRESSURE-TIGHT PACKING UNIT CANNOT EXTRUDE

★ DOES NOT REDUCE I.D. OF CASING STRING

★ DOES NOT DISTURB CASING CEMENT JOB

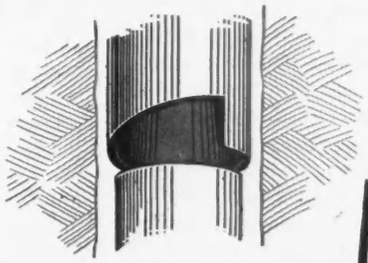


It's the BAASH-ROSS PACKING CASING BOWL

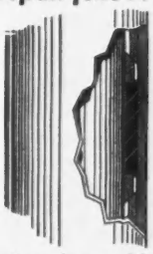
***Repairing damaged or split casing strings is an easy, foolproof operation when you use this field-proven tool that has long been a dependable standby among leading operators throughout the world. It's the Baash-Ross Packing Casing Bowl—and it offers a number of important advantages on modern casing repair jobs . . .***

## Easy to Install!

Here's all you do to make a quick positive casing repair with the Baash-Ross Casing Bowl. First, cut the casing below the defective area (Baash-Ross makes a cutting tool that is ideal for this job!) and remove the upper portion of the string from the well. Discard the defective portion of the string, replace with good casing and attach a Packing Casing Bowl to the bottom of this replacement string. After the repaired casing string is run back into the well, it is lowered until the top of the casing standing in the hole passes completely into the Casing Bowl and seats against the shoulder in the upper portion of the Bowl.



Then the string is simply raised a short distance to set the slips and expand the lead packing to a permanent, pressure-tight fit against the casing in the well . . . the casing suspended at the surface in the usual manner to retain the tension . . . *and the job's done!*



**FOOLPROOF PACKING ELEMENT**

Note in the cutaway view of the Packing Casing Bowl how the upper and lower steel rings that retain the lead packing elements have a compressible joint like a piston ring. This permits them to close around the pipe along with the lead as it expands, thus preventing the lead from extruding out of the packing area. Result—a tight leakproof pack-off between the old and new casing sections, without need for cementing or other complicated sealing operations!

**FULL INSIDE DIAMETER**

Another important advantage is that the *minimum* inside diameter of the Baash-Ross Casing Bowl is equal to that of the Casing to which it is attached. Any tools, liners or other equipment that will pass through the casing string will also pass through the Casing Bowl without hanging up!

**CEMENT JOB IS UNAFFECTED**

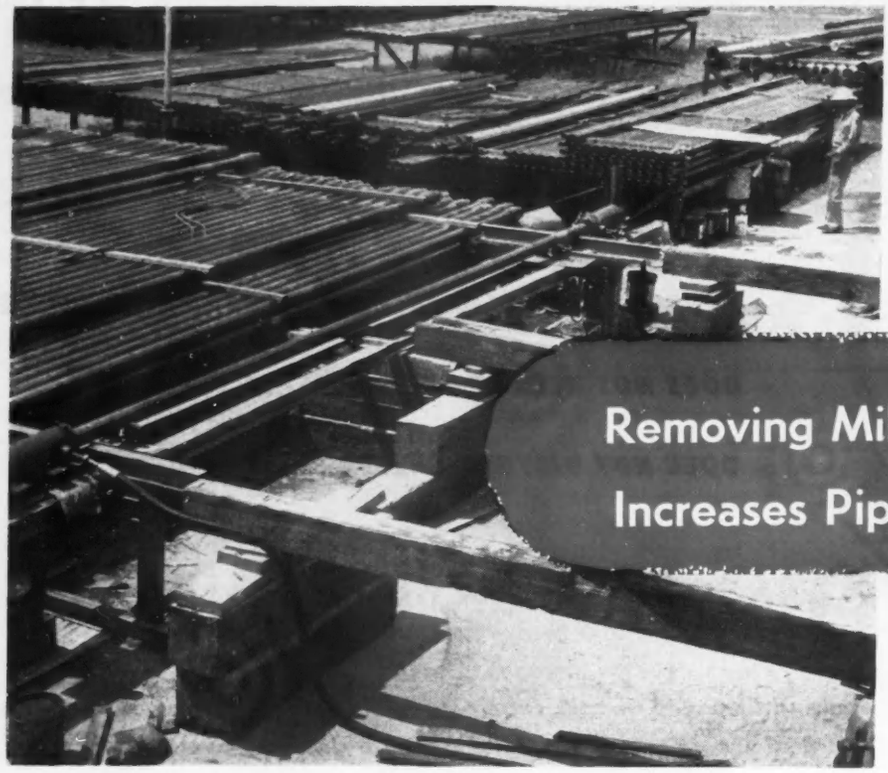
Since the Packing Casing Bowl attaches to the top of the casing standing in the hole, the cement shut-off around the shoe is not disturbed. This, coupled with the tight leakproof joint effected between the Casing Bowl and the casing in the hole, assures the repaired string being just as watertight as the original casing job.

### TWO TYPES—FULL RANGE OF SIZES

Baash-Ross Packing Casing Bowls are available in two types—one with a *single* set of slips for gripping the top of the casing in the hole for use with short strings of casing . . . and the other with a *double* set of slips where extra gripping efficiency is desired on longer casing strings. In both types the packing element is essentially the same.

Both the Single and Double Slip Types are available in a complete range of casing sizes. In each size the O.D. of the Casing Bowl is not much greater than that of the casing joints, so that it can readily be run inside the surrounding casing of standard casing programs. Made of heat-treated alloy steel, each size of Casing Bowl has ample strength to withstand the most severe strains and pressures with a high safety factor.

*Available through leading supply stores*



# Removing Mill SCALE Increases Pipe Service Life

By RALPH IRVING
General Manager, Vapor Honing Company, Houston

REMOVING mill scale from the inside of tubular goods will increase field service life by 50 percent, it was found in a five-year study conducted by A. W. Thompson, president of Thompson-Carr, Inc., Houston drilling contracting firm, and president of the American Association of Oilwell Drilling Contractors.

The corrosion premises which explain this increase in pipe life are:

- Pipe fails due to corrosion pits and the cracks resulting therefrom.
- If the mill scale is allowed to weather or spall-off new pipe the corrosion pits will be three times worse than if the mill scale is blasted-off. Mill scale naturally weathers off in spots (buckshot rust) or spalls-off in chips. The adjacent bare and covered spots are ideal sources of the electrical differences or galvanic cells which promote pitting.
- The actual total weight loss due to corrosion is so small that if it were evenly distributed, instead of concentrated in pits, pipe theoretically could last ten times as long as it does even in very corrosive environments.

The accompanying photograph illustrates a typical field installation for sand blasting and shot peening tubular goods. It may be noted that the rolling device is centered between two racks for rapid handling of the pipe. A pressurized flow of abrasive is introduced through a long pipe nozzle which permits full coverage of a joint. Visual inspection of the blasted pipe is made possible by means of mirror concentrated light. Aside from the air compressing facilities, the modern blasting plant is equipped with drying devices to precess the abrasive substance prior to its use.

**A DISCUSSION of sand blasting tubular goods, this article describes application of the method in instances where the life of drill pipe has been increased 50 percent. Employment of the method offers particular advantages during the shortage of tubular goods. Being closely associated with the process of shot peening, the removal of mill scale and foreign matter by sand blasting seemingly assures extended service for oil field tubular goods. A forthcoming issue of WORLD OIL will include another article by Irving on the technique and advantages of shot peening pipe.**

When the mill scale is removed, the corrosive action is immediately more evenly distributed over the inside diameter rather than concentrated in spots. The objective is to secure 100 percent holidays in mill scale (painters use the expression "holiday" to denote the absence of protective coating). Whatever the quality control deviation from 100 percent may be in the original process, the natural predisposition of mill scale to corrode off by weathering allows corrosion to work for us instead of against us and makes 100 percent holidays eventually attainable.

Removing mill scale from the inside is only one of the economically feasible processes that may increase the service life of tubular goods. Shot peening, after removing the mill scale, has an impressive record of increasing the number of cycles of stress a steel surface will withstand and is specifically indicated for drill stem.

More than at any other time, tubu-

■ CONTINUED ON PAGE 151

*A Review of*

# Casing String Design, Principles, and Practice

## *Part 2* (Conclusion)

**(Part 1 Appeared in July 1, 1951, WORLD OIL)**

By J. O. HILLS

**Assistant Manager, Production Engineering and Equipment Section, General Petroleum Corporation**

**IN CONCLUSION, this article presents simplified graphics which will expedite the exacting determination of casing string design. Mud weights, grades, collapse and tension factors are taken into consideration in the graphic fabrication of casing string formula. Field application of these data will eliminate the need for voluminous tubular goods handbooks and complicated mathematical formula.**

IT IS desirable that the method of design be as simple as possible. However, it should not restrict the choice of safety factors, loading conditions, kinds of pipe and joints, or other design assumptions. Direct step-by-step mathematical methods, although not basically difficult to understand and apply, are time consuming and involve a great deal of cut-and-try computation. This is especially true if an attempt is made to compare various possible combinations of pipe in the string. A complicated or tedious procedure discourages search for the best design, and encourages the use of over-simplified assumptions.

A graphical method developed by W. C. Main and published in the information booklet of a pipe manufacture[30] appears to be the best casing string design method available at present. It has the following advantages:

- Any desired mud weights, safety factors, and design assumptions can be used, and trials of various combinations of weights, grades, and joints can be made easily.
- Rather complicated string can be designed in 15 minutes.
- For each size of casing, all the necessary strength data can be on the design chart.
- The finished design can be checked readily.
- Relatively inexperienced personnel can learn to use the method quickly.

This method is illustrated by Figure 9 for seven inch O.D. casing. A separate chart is needed for each casing size. This design chart provides:

- A means of determining graphically the collapse loading in terms of mud weight and collapse safety factor.
- A graphical representation of the variation of casing collapse resistance with longitudinal tension load.
- Plotted points on the collapse strength curves showing allowable tension loads for various joints.
- A means of constructing a tension load vs. depth curve.

This chart can be simplified to almost any extent desired, although simplification sacrifices flexibility. If only one collapse safety factor is to be used, this factor can be incorporated in the mud weight scale and mud weight can be used directly. If only one safety factor and one mud weight are to be used, the entire left portion of the chart becomes a single vertical line graduated in depths, and the construction of the tension load vs. depth curve is simplified.

With all conditions fixed, the chart will become identical to the type described by Cooley[31, 32] and illustrated by Figure 10. It is very simple to apply, but almost no variations can be made from the assumptions on which the chart is based.

It is probable that less effort has been spent on design of individual casing strings than on other structures of comparable cost and importance. It cannot be said that this results in unsafe casing strings since with present practice there are few failures; so additional effort spent on design can pay off only by reducing cost without increasing the frequency of failures. To accomplish this it will be necessary to apply design principles and practices which recognize as fully as possible the true loading and service conditions. Present knowledge allows much to be done in this direction, but there is continuing need for analysis and tests leading toward a still more complete understanding of the problems of casing string design.

## *Appendix*

### Construction of Design Chart

A more complete explanation of construction of the design charts shown in Figures 9 and 11 is available in the informational booklet of a pipe manufacturer.[30] Figure 9 is essentially the same chart as shown therein with modifications as follows:

- The curves of collapse strength versus tension load have been extended into the region of compression.
- The steep right hand sections of these curves are corrected for 1.125 collapse safety instead of 1.25.
- One type of High Strength joint has been added.
- API bursting yield strengths have been tabulated at the lower right hand corner of the chart.
- The line used for origin of slope points is separate from the left hand graph, and is marked with S at its top.

The following example (See Fig-

ure 11) will illustrate the use of this design chart and can serve as general instructions since all designs will follow the same procedure.

**Conditions:**

Size—Seven inch O.D., depth—13,500 feet.

Collapse loading—Equivalent to 75 lb. per cu. ft. mud.

Bursting loading—4500 psi to 2000 ft. decreased by external pressure of 72 lb. per cu. ft. mud (.5 lb. per ft.) from 2000 ft. to bottom.

**Safety Factors:**

Tension—2.00 on API joint strength
1.5 on minimum yield of pipe wall

Collapse—1.125 on API Collapse Strength except may approach 1.0 at bottom.

Bursting—1.50 on API Internal Yield Pressure.

● Draw vertical "Program Line" (1) at $(75 \times 1.125) = 84.5$ on Mud Weight $\times$ Safety Factor in Collapse scale. This line becomes the depth scale for design.

● Locate air weight slope point $S_A$ by drawing a horizontal line (2) from the 10,000-foot depth point on the Program Line to the Slope Point Line.

● Locate buoyancy slope point $S_B$ as follows: From intersection of curved buoyancy line and actual mud weight (A) move parallel to slanting depth lines (3) until program line is reached. Then move horizontally (3) to slope point line at $S_B$.

● Draw horizontal line (4) from 13,500-feet on Program Line to zero tension load—Point C. This indicates that 32 pound N-80 probably will be satisfactory at bottom of the string.

● Determine compression in pipe at bottom as follows: From C draw a line (5) paralleling $S_B$-32 to Point D at top of chart. Then from D draw line (5) paralleling $S_A$-32 to E on Line 4. CE represents the buoyant force on the bottom of the 32-pound pipe, and E is the point from which the design load line starts. This point may be calculated as follows, in which case the "buoyancy line" is not needed. Area of 32-pound pipe $= \frac{32}{3.4} = 9.4$ sq. in.

Pressure at 13,500-foot $= \frac{13{,}500(75)(.433)}{62.4} = 7020$ psi.

Compression load $= 9.4\ (7020) = 66{,}000$-pounds $=$ CE

● Check actual collapse safety factor at bottom as follows:

Actual pressure at 13,500-feet $=$ 7020 psi.

Collapse strength of 32-lbs. N-80 corrected for compression of 66,000-lbs. is 7700-psi.

Collapse S.F. $= \frac{7700}{7020} = 1.09$, and is satisfactory.

● Draw a line (7) through E paralleling $S_A$-32 and passing through the 29-lb. N-80 line a short distance. Starting near this crossing (10,600-foot depth) 29-pound N-80 can be used. Since there will be a $\frac{32\text{-}29}{3.4} =$ .88 square inch area change with the lighter weight above, the tension load will increase at that point by .88 $\times$ mud pressure at 10,700-feet, and .88 $\times 5500 =$ approximately 5000 pounds. Locate Point F on the 29-pound N-80 line at 5000-pound tension load to the right of the line (7) just drawn upward from E.

● From F draw a line paralleling $S_A$-29 and proceed as in Step 7, establishing Point G above which 26-pound N-80 can be used.

● From G proceed similarly, establishing Point H above which 23-pound N-80 can be used.

● From H draw a line (10) upward, paralleling $S_A$-23.

● At this time the factors of bursting and tension must be considered. From tabulation at the lower right, API bursting yield strength of 23-pound N-80 is 6340-psi, and allowable working pressure with 1.5 S.F. is $\frac{6340}{1.5} = 4200$-psi. From the bursting load assumption, 4200-psi differential pressure will ocur at 2600-foot depth.

Draw horizontal line (11) from 2600-foot depth on Program Line to intersect line (10) coming up from H. Above this point (J), 26-pound N-80 must be used to meet the bursting requirement. From the allowable joint loads shown on the 23-pound N-80 line, it can be seen that both long and short regular API joints have allowable loads less than the 240,000-pound load at Point J but the high strength 23-pound N-80 joint at 270,000-pound allowable load will be satisfactory.

● At J make tension correction for area change which will be negative since the higher weight is on top. $\frac{.88 \times 2600 \times 75 \times .433}{62.4} = 1200$-pound reduction in tension load.

● From the corrected Point J draw a line (13) upward parelleling $S_A$-26 to intersect the top of the chart at K.

● The tension load (at Point K) is 311,000-pound. The 26-pound N-80 LT&C high strength joint plotted has an allowable load of 312,000-pound and, therefore, is satisfactory.

● Draw horizontal lines (15) from F, G, and H to Program Line.

● At the points of intersection L, M, N, P of lines 15 and 11 with the Program Line, read the depths of the changeover points.

● Record these depths in the casing program column at the left of the chart, together with the length and specification of each section.

The program, assuming Long Threaded and Coupled joints throughout, is then as shown in Table 2.

It happens that in this string the overpull necessary to stress the three top sections to their minimum ultimate joint strength is very nearly the same in spite of the 2.26 and 2.88 minimum safety factors in the lower two of these sections.

**TABLE 2**

| Interval | Length | Size | Weight | Grade | Joint | SAFETY FACTOR C | T | B |
|---|---|---|---|---|---|---|---|---|
| 0- 2600 Feet | 2600 | 7" | 26# | N-80 | High Strength | High | 2.03 | 1.60 |
| 2600- 5800 Feet | 3200 | 7" | 23# | N-80 | High Strength | 1.125 | 2.26 | 1.50 |
| 5800- 8200 Feet | 2200 | 7" | 26# | N-80 | Long T&C | 1.125 | 2.88 | High |
| 8200-10600 Feet | 2600 | 7" | 29# | N-80 | Long T&C | 1.125 | High | High |
| 10600-13500 Feet | 2900 | 7" | 32# | N-80 | Long T&C | 1.09 | High | High |

### Landing Practice

De Hetre's equations for changes of load due to temperature and pressure changes in casing are as follows:

Temperature change

$P = 58.2\ W\Delta T$

where

P = Change in load at landing head (pounds)

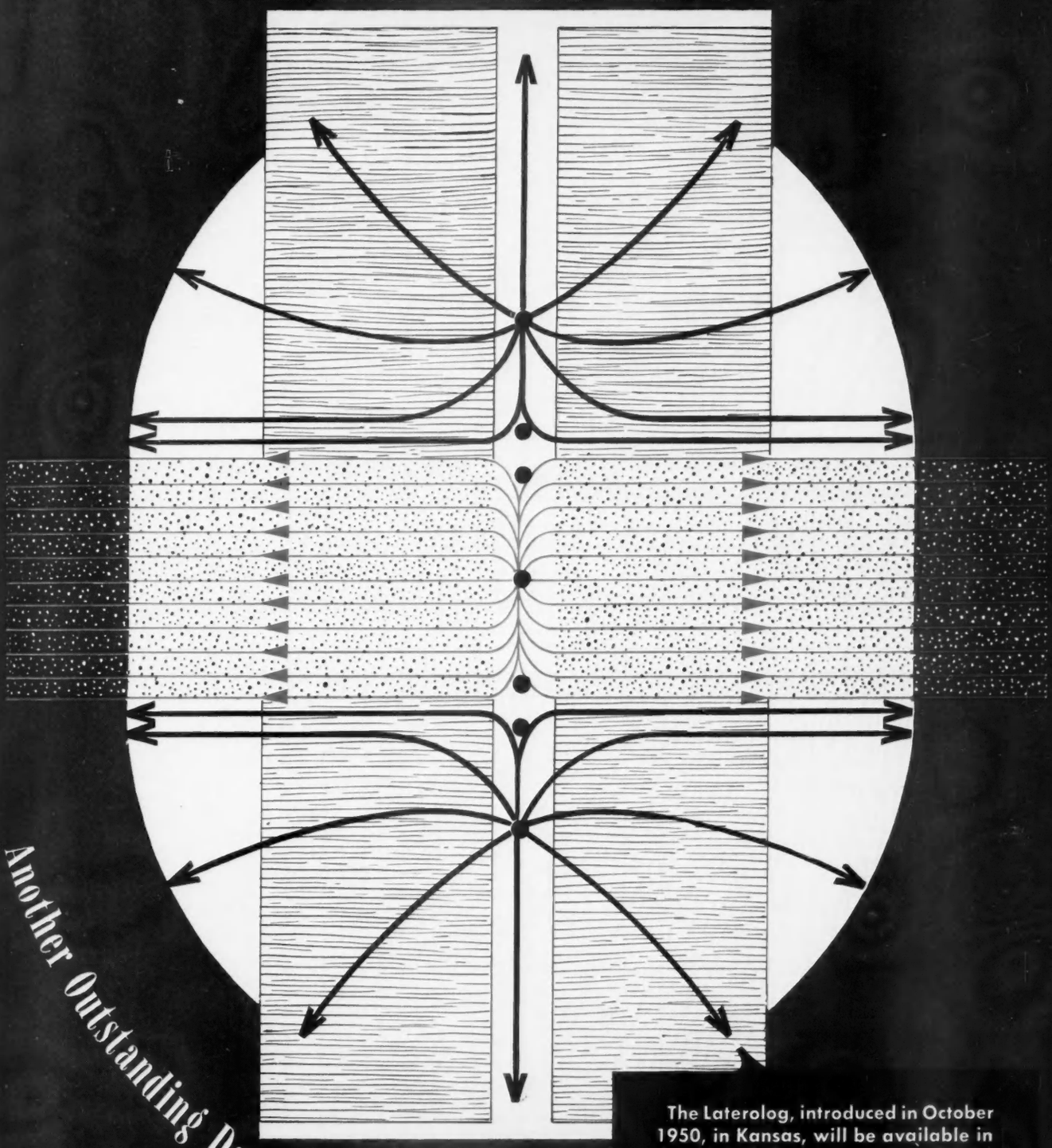
W = Nominal pipe weight (pounds per foot)

$\Delta T$ = Average temperature change of free casing (degrees F.)

A temperature drop results in an increased load, while a temperature

# ANNOUNCING

## *The* LATEROLOG



The Laterolog, introduced in October 1950, in Kansas, will be available in the United States on an industry-wide basis by January 1952. Write for further information.

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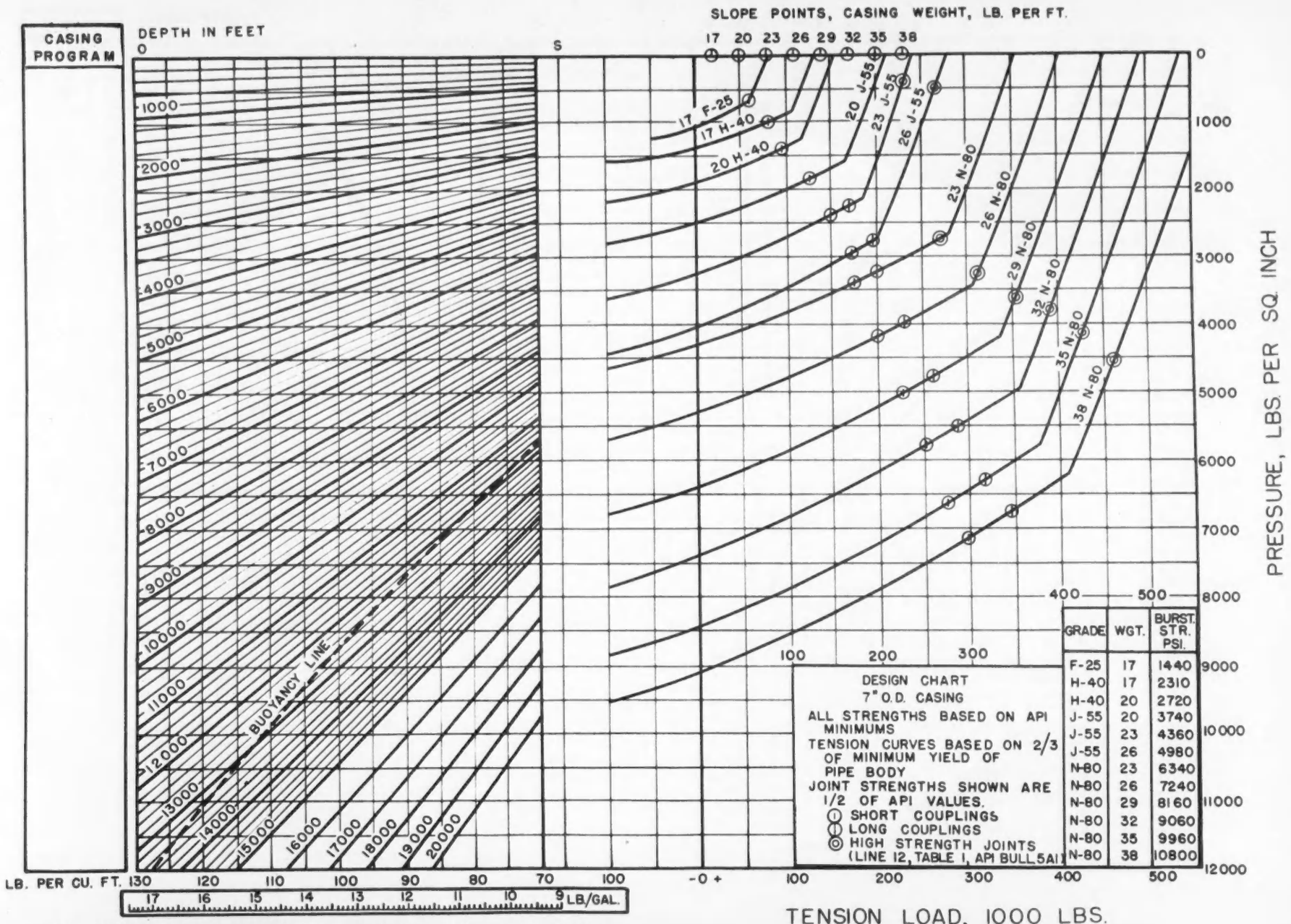
CASING PROGRAM
DEPTH IN FEET
SLOPE POINTS, CASING WEIGHT, LB. PER FT.
17 20 23 26 29 32 35 38
17 F-25
17 H-40
20 H-40
20 J-55
23 J-55
26 J-55
23 N-80
26 N-80
29 N-80
32 N-80
35 N-80
38 N-80
BUOYANCY LINE
LB. PER CU. FT.
LB/GAL.
MUD WEIGHT X SAFETY FACTOR IN COLLAPSE
TENSION LOAD, 1000 LBS.
PRESSURE, LBS PER SQ. INCH
DESIGN CHART
7" O.D. CASING
ALL STRENGTHS BASED ON API MINIMUMS
TENSION CURVES BASED ON 2/3 OF MINIMUM YIELD OF PIPE BODY
JOINT STRENGTHS SHOWN ARE 1/2 OF API VALUES.
SHORT COUPLINGS
LONG COUPLINGS
HIGH STRENGTH JOINTS (LINE 12, TABLE 1, API BULL 5A1)
GRADE | WGT. | BURST. STR. PSI.
F-25 | 17 | 1440
H-40 | 17 | 2310
H-40 | 20 | 2720
J-55 | 20 | 3740
J-55 | 23 | 4360
J-55 | 26 | 4980
N-80 | 23 | 6340
N-80 | 26 | 7240
N-80 | 29 | 8160
N-80 | 32 | 9060
N-80 | 35 | 9960
N-80 | 38 | 10800

FIGURE 9

# Here's the Answer to ECONOMICAL SERVICING!

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**COOPER ALLIS-CHALMERS..**

# Model M318-32 WINCHES

**Conservatively Rated to 4,000 ft. of 2½" Tubing.**

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***Popular*** **because of their very low cost.**

**MANY IMPROVEMENTS AND MODERN FEATURES:**

**Vacuum, air or convenient mechanical controls —all easier for the operator, faster and safer at the well, and more rugged for even longer trouble-free service.**

**Powered by Allis-Chalmers U318 Engine and built throughout by the COOPER—ALLIS-CHALMERS organizations specializing in Well Servicing Equipment for more than 33 years.**

***Winch Brakes:*** **32" dia. x 6" face; 8 line speeds from 52 ft.p.m. to 736 ft.p.m.; line capacity 3700 ft. of ¾". Maximum line pull 20,000 lbs.**

**Model 318-32 Winches are built as Single or Double drum skid units, trailer units and self-propelled tractor units. All units are available with Rotary Drive, Cooper quick-drop spudders, jerkline spudders and telescoping masts.**

**Regardless of the depth of wells, there is a Cooper-Allis-Chalmers Winch of the right capacity to do the job economically.**

## FRED E. Cooper, Inc.

**P. O. Box 1890 TULSA, OKLA.**

**Houston, Odessa, Los Angeles**

**Western Canada: Rocky Mountain Supply Co., Ltd., Calgary, Edmonton, Redwater**

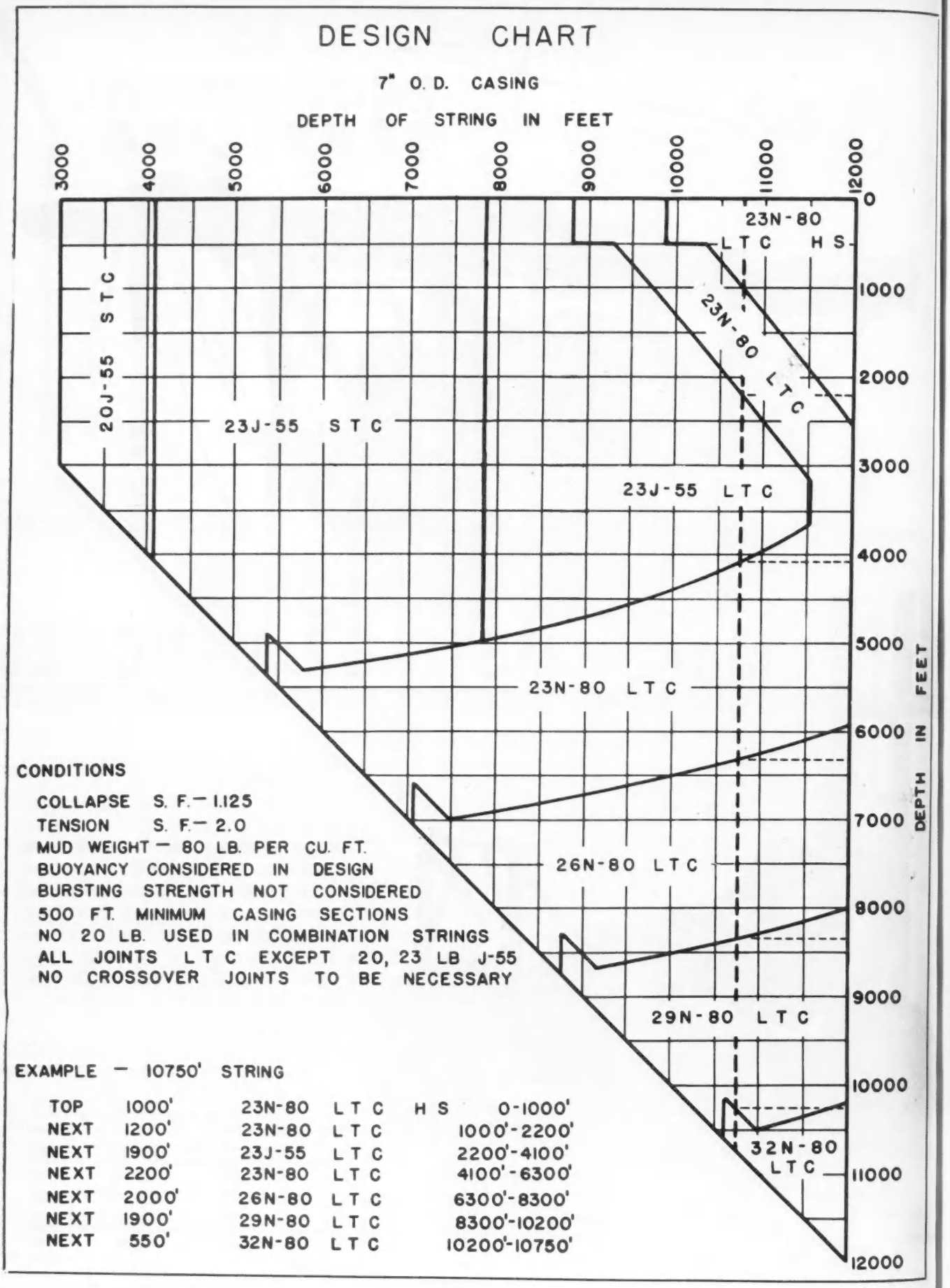
DESIGN CHART
7" O. D. CASING
DEPTH OF STRING IN FEET
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
DEPTH IN FEET
20J-55 STC
23J-55 STC
23N-80 LTC HS
23N-80 LTC
23J-55 LTC
23N-80 LTC
26N-80 LTC
29N-80 LTC
32N-80 LTC
CONDITIONS
COLLAPSE S. F.— 1.125
TENSION S. F.— 2.0
MUD WEIGHT — 80 LB. PER CU. FT.
BUOYANCY CONSIDERED IN DESIGN
BURSTING STRENGTH NOT CONSIDERED
500 FT. MINIMUM CASING SECTIONS
NO 20 LB. USED IN COMBINATION STRINGS
ALL JOINTS L T C EXCEPT 20, 23 LB J-55
NO CROSSOVER JOINTS TO BE NECESSARY
EXAMPLE — 10750' STRING
TOP 1000' 23N-80 L T C H S 0-1000'
NEXT 1200' 23N-80 L T C 1000'-2200'
NEXT 1900' 23J-55 L T C 2200'-4100'
NEXT 2200' 23N-80 L T C 4100'-6300'
NEXT 2000' 26N-80 L T C 6300'-8300'
NEXT 1900' 29N-80 L T C 8300'-10200'
NEXT 550' 32N-80 L T C 10200'-10750'

FIGURE 10

# *The Murfin Drilling Company of Wichita, Kansas gets long runs and straight hole with* **REED** *Rock Bits*

We are well pleased with the long runs and straight hole we get with Reed Rock Bits. Your bits help us keep down drilling costs.

Yours very truly,

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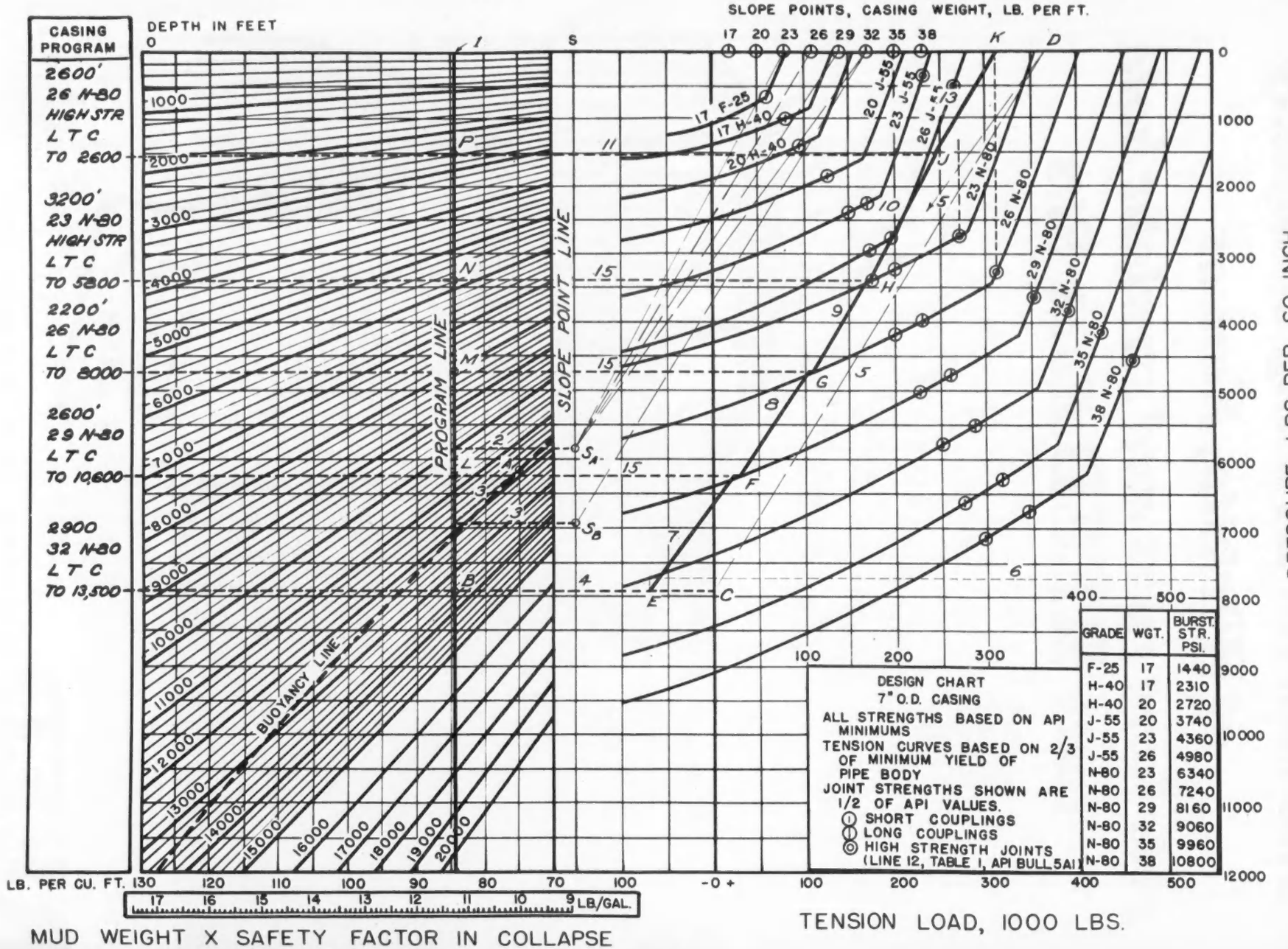
CASING PROGRAM
2600' 26 N-80 HIGH STR LTC TO 2600
3200' 23 N-80 HIGH STR LTC TO 5800
2200' 26 N-80 LTC TO 8000
2600' 29 N-80 LTC TO 10,600
2900 32 N-80 LTC TO 13,500
DEPTH IN FEET
PROGRAM LINE
BUOYANCY LINE
LB. PER CU. FT. 130 120 110 100 90 80 70
17 16 15 14 13 12 11 10 9 LB/GAL.
MUD WEIGHT X SAFETY FACTOR IN COLLAPSE
SLOPE POINT LINE
SLOPE POINTS, CASING WEIGHT, LB. PER FT.
17 20 23 26 29 32 35 38
17 F-25
17 H-40
20 H-40
20 J-55
23 J-55
26 J-55
23 N-80
26 N-80
29 N-80
32 N-80
35 N-80
38 N-80
100 200 300
-0 + 100 200 300 400 500
TENSION LOAD, 1000 LBS.
PRESSURE, LBS. PER SQ. INCH
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000
DESIGN CHART
7" O.D. CASING
ALL STRENGTHS BASED ON API MINIMUMS
TENSION CURVES BASED ON 2/3 OF MINIMUM YIELD OF PIPE BODY
JOINT STRENGTHS SHOWN ARE 1/2 OF API VALUES.
SHORT COUPLINGS
LONG COUPLINGS
HIGH STRENGTH JOINTS (LINE 12, TABLE 1, API BULL.5A1)

| GRADE | WGT. | BURST. STR. PSI. |
|---|---|---|
| F-25 | 17 | 1440 |
| H-40 | 17 | 2310 |
| H-40 | 20 | 2720 |
| J-55 | 20 | 3740 |
| J-55 | 23 | 4360 |
| J-55 | 26 | 4980 |
| N-80 | 23 | 6340 |
| N-80 | 26 | 7240 |
| N-80 | 29 | 8160 |
| N-80 | 32 | 9060 |
| N-80 | 35 | 9960 |
| N-80 | 38 | 10800 |

FIGURE 11

rise results in a decreased load.

Pressure change

$$P = 0.0434\ W\Delta p\ \frac{D}{t}$$

where

P = Change in load at landing head (pounds)

W = Nominal pipe weight (pounds per foot)

ΔP = Average net pressure change in free pipe (psi)

D = Casing outside diameter (inches)

t = Casing wall thickness (inches)

When the net pressure change is an internal increase, the change of load at the landing head will be an increase. When the net pressure change is an internal decrease, the change of load at the landing head will be a decrease.

### Bursting Pressures

The following approximate formula can be used to calculate the maximum surface pressure in a well full of dry gas at a known or assumed bottom hole pressure.

$$P_S = \frac{P_B}{1 + .02D}$$

where

$P_S$ = Pressure at surface, pounds per square foot.

$P_B$ = Bottom hole pressure, psi.

D = Depth, thousands of feet.

FIGURE 11

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## Removing Mill Scale

■ CONTINUED FROM PAGE 140

lar goods are doomed to a short service life because of pits which start during storage. Therefore, now being investigated are coatings which provide excellent corrosion resistance but possess poor adherence characteristics, and which protect during storage but will fail, or go to pieces, when the pipe is put in use. If the coating does not fail quickly, there is a probability of re-establishing the adjacent bare and covered spots, ideal for electrolytic action, as in the natural spalling-off of mill scale.

Such a protective system, sandblasting plus a temporary coating, may be the answer pipe corrosion engineers have been looking for. Field operation has indicated that it is not feasible to go back inside two or more field welded lengths to achieve a homogeneous coating over the weld seams. With the application of the above technique, this may not be necessary.

In any case, Thompson's data and valid corrosion premises confirm that if you remove mill scale from the inside of pipe to approach 100 percent holidays, the expected life of pipe will be increased at least 50 percent.

## About the Author

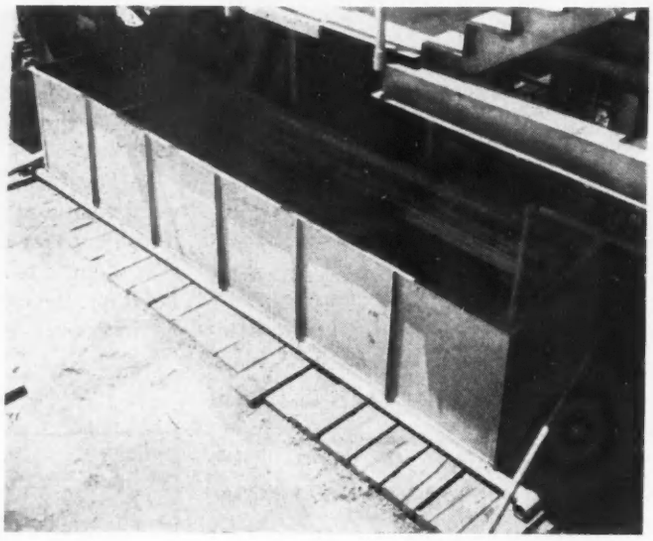
RALPH IRVING, general manager of Vapor Honing Company, has had training and long experience in industrial engineering and management consultation with major companies. Following World War II, Irving joined Hughes Tool Company as chief industrial engineer. His association with Vapor Honing Company has led to a concentrated study of surface preparation for the development and application of corrosion resistant coatings. Irving has invested additional time in the technique of shot peaning tubular goods.

# DRILLING HINTS

**$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas**

## HOW TO—Cool and Conserve Drawworks Brake Water

The operation of drilling rigs in arid areas requires the installation of a device to cool brake water, a requisite which can be satisfied by the construction of a skid mounted, metal circulating tank. The installation assures conservation of water and if the operator prefers maximum unitization, the tank can be built within the substructure.



The illustrated unit, which is 30 feet long, 5 feet high and 5 feet wide, is built of heavy gauge sheet metal. Initial construction of the tank involved fabrication of a 4½-inch drill pipe skid base. The end of the skid unit should be designed to extend beyond the tank to permit convenient handling on location. Each end of the skid member is equipped with a 4½-inch snub bar to accommodate the truck winch line. Complete suport of the tank is assured by the placement of 4½-inch reinforcing members in the skid base.

At this point, a two-inch angle iron frame, supported by 1½-inch angle iron vertical reinforcing elements, is laid out, welded and attached to the skid base. The V segment of the angle iron should face toward the inside of the tank on the base and side framing. The top frame should be attached with the V facing down.

With completion of the skid base and frame, heavy gauge sheet metal is cut and welded to the structure to form the finished tank. One end of the tank is equipped with a three-inch suction flange bolted to the metal panel. The discharge line from the brake is suspended above the tank to allow water to drop on a splash tray for the purpose of uniform fluid distribution and expediting the cooling process. Fluid level within the tank is maintained through the introduction of water through a rubber hose connected to the rig fresh water system.

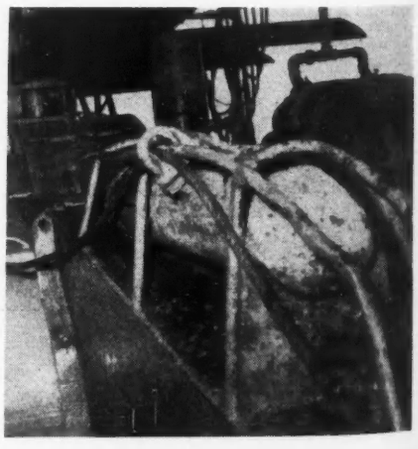
This tank will provide an adequate supply of water for cooling the drawworks brake, and the area of the tank is of a magnitude to assure complete and rapid cooling of the water even during trips. Although the unit is large, by removing the water it offers no problem in transport. Minor alterations in the basic design will permit permanent installation of the tank within the substructure member.

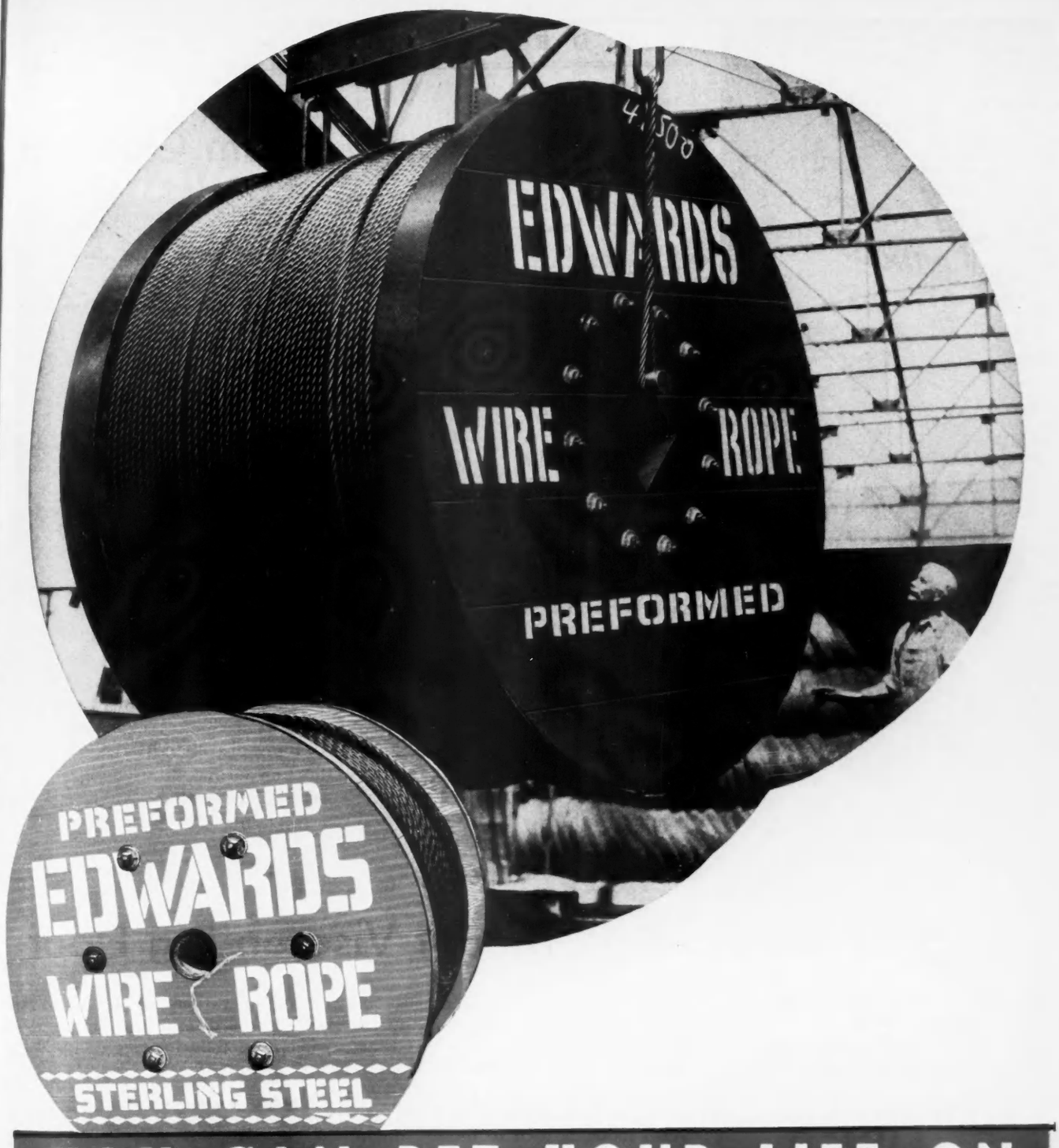
## HOW TO—Control Wild Tong Lines

The danger of personnel injury from lashing tong lines can be reduced by guiding the line through an anchored clamp. The installation is simple, inexpensive and efficient in the direction of providing safe working conditions.

The illustrated clamp is attached to the sucker rod frame of the rotary chain lubricator. In the event a comparable structure is not present on the chain guard, the clamp can be connected to a notch cut in the guard or to a steel rod guide welded thereon.

This line guide will also govern the path of the break-out tongs if the cathead is accidentally engaged. Instead of cutting a swath across the derrick floor, the wild tong will be jammed into the chain guard and the possibility of serious injury to crew members will be reduced.



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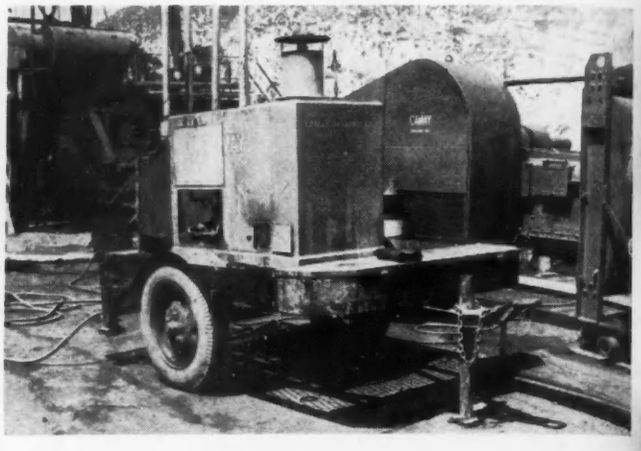
# HOW TO—Transport Steam Cleaner



The portability of steam cleaning units can be increased by attaching the equipment to a trailer. The trailer is constructed with an axle from a 1½-ton truck with wheels designed for 7.50 x 20 tires. The frame of the trailer, which serves as the bed for the cleaning unit, is made of angle and channel steel. The cleaning unit is mounted above the axle in such a manner that the balanced weight makes handling the unit relatively simple.

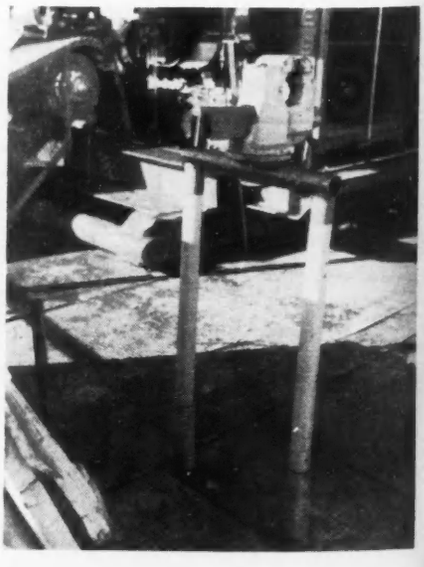
The steam hose is stored in a box attached at the tongue of the trailer. Necessary wrenches and fittings are also stored in this box, which has a heavy, flat cover suitable for use as a work bench in making light equipment repairs. The tongue has a "D" handle which may be easily grasped by a man when moving the unit around a rig.

Steps, covered with heavy mesh, are attached to the back of the trailer. Support legs, with box-shaped pads to conform with cribbing, are hinged to the trailer bed. Weight of the unit is evenly distributed by a post set in the tongue and adjusted to the desired height with matching holes in a sleeve and pin assembly.

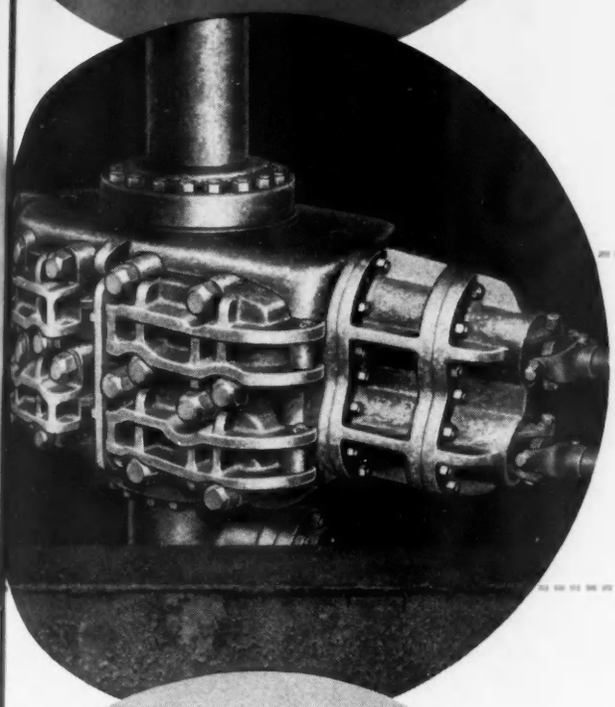
# HOW TO—Mount Vise on Rig Floor

One of the disadvantages of mounting a vise on the bench set up on the derrick floor is the fact that, although it is usually conveniently located, insufficient room to handle long pieces of material or pipe often prevents its being used to the maximum advantage.

Eliminating some of this disadvantage is the semi-portable vise stand that one operator sets up at any convenient point on the floor of his rig, in a position that will provide a maximum amount of working space around it. Made of two-inch pipe, the two-legged support rests in extra long sockets welded to the rig floor, the latter providing for all practical purposes, the stability required for average work. It is allowed to remain set up for most of the time, but it is picked up easily and quickly whenever the space is needed for moving equipment or materials. Likewise, the unit can be transported easily during moving operations and it can quickly be reinstalled and put into service when needed during rigging-up at the new location.



# You get not 1, or 2 but FIVE vital advantages in SHAFFER HYDRAULIC CELLAR CONTROL GATES!

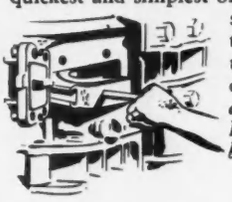


## 1 GREATER COMPACTNESS

The Shaffer Hydraulic Cellar Control Gate saves space in *all three* dimensions—height, width and length. This important saving gives more room in the cellar for other equipment . . . permits more compact rig installations . . . reduces cellar depth requirements to a minimum. Even in sizes as large as 13⅜" (12" Series 900) the Shaffer Hydraulic *Double* Gate—providing *two* separate ram compartments unitized into *one* body—requires as little as 30" total height . . . the Shaffer Hydraulic *Single* Gate as little as 18½" total height. *Compare these dimensions with any other gate of the same size!*

## 2 EASIER RAM CHANGES

In Shaffer Hydraulic Cellar Control Gates ram-changing is by far the quickest and simplest of *any* gate. Simply unbolt two doors in the side of the body, swing them open, slide out the old rams, slide in the new, close and bolt the doors. There's nothing to disengage or disconnect—and closing the doors *automatically* aligns the rams for proper operation. *Equally important, complete ram changes can be made whether pipe is in or out of the hole!*



## 3 NO MUD PROBLEMS

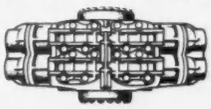
With Shaffer Gates you don't have to worry about mud or sand interfering with free ram travel when emergencies threaten. The rams travel on high narrow guide ribs above the steeply-sloped ram compartment bottoms. Mud and sand quickly drain back into the well—with no space for detrimental accumulations to interfere with ram operation!

## 4 UNEQUALLED DEPENDABILITY

In Shaffer Hydraulic Gates, the operating cylinders are *directly behind* the rams with no complicated multiple-element connections to wear or fail. Direct one-piece connection assures trouble-free action, greater simplicity, positive dependability!

## 5 MAXIMUM SAFETY

In Shaffer Hydraulic Gates all moving parts—including piston rod ram shafts—are completely enclosed within the Gate body. There are no exposed moving parts to become wedged or damaged by objects falling into the cellar—nothing to become corroded by chemical or salt drippings. Even the locking shaft is non-rising—fully protected!



***When one product gives clear-cut leadership on every desirable feature in its field, you can rest assured that that product will—by all standards—give outstanding performance!***

**And that's why operators throughout the oil industry have established the Shaffer Hydraulic Cellar Control Gate as the outstanding choice—because on every single point essential to modern cellar control gate protection, this unit is unsurpassed**

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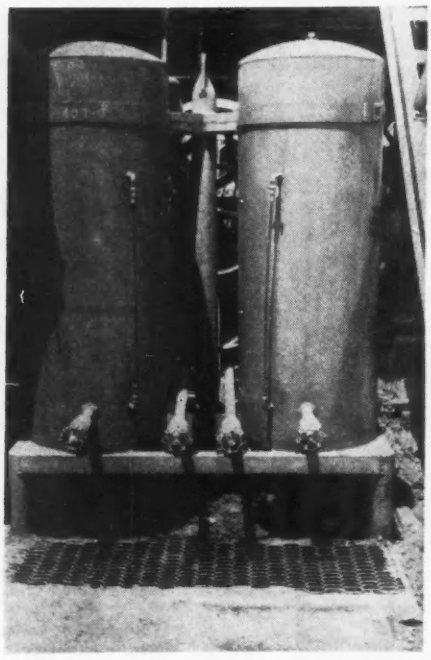
***Send for your free copy of the 1951 Shaffer Catalog!***
***See pages 4525 to 4600 of your 1951 Composite Catalog!***

# HOW TO—Construct Pressurized Lube Oil Dispenser

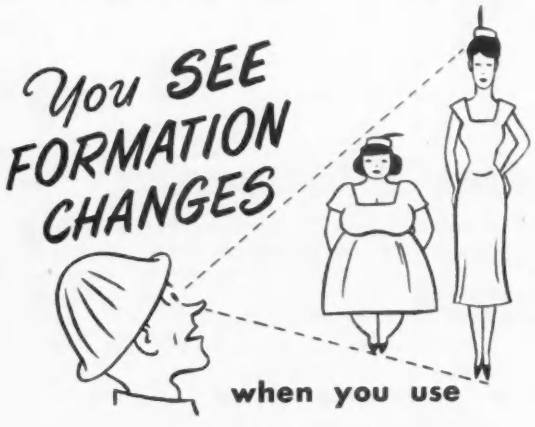
The problem of cluttering a location with empty oil drums can be overcome by the construction of an inexpensive, pressurized lube dispenser. The unit base is fabricated of two-inch pipe reinforced with two-inch strap metal. Heavy gauge sheet metal is welded to the legs to provide a platform for the tanks to rest on. Part of the skid unit consists of an expanded metal platform immediately below the dispensing valves. This platform extension facilitates handling in transport and the expanded metal cover enables rig personnel to avoid standing in oil which may escape from the valves.

A three-inch center post is welded securely to the heavily reinforced tank platform. The lube tanks, which are tack welded to the base platform, are anchored to the center post by means of tie-bolted bands. The center post is equipped with a heavy bail at the top to accommodate a hook suspended from gin poles. Each tank is supplied with one-inch flanges to adapt a short nipple and angle globe valves. The rear tanks have longer extensions so that oil can be collected from all four units on one side of the rack.



Each tank is supplied with a quarter-inch gauge glass so that the lube volume in each container can be determined conveniently.

The tanks are filled by introducing air pressure into the shipping drums by means of a long lance packed in one of the drum openings. In turn, low pressure can be maintained within the oil despensers to expedite the process of collecting oil from the containers.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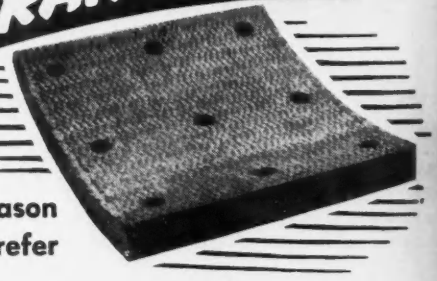

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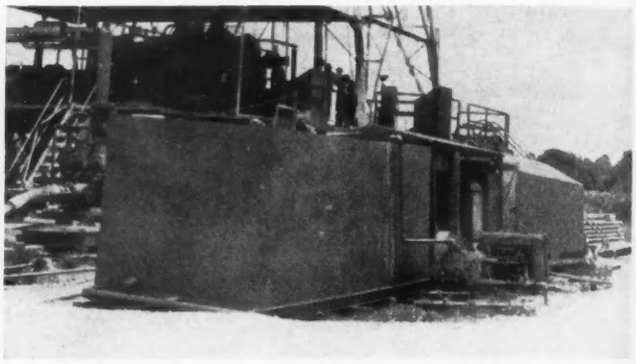
# HOW TO—Maintain Reserve Mud



A reserve mud tank will provide added insurance for the quick handling of lost circulation and potential blowouts on critical drilling operations. One operator has provided this safety measure by placing a steel mud tank near the pumps. Drilling fluid from the earthen circulating pits is transferred to the emergency tank by means of a small, portable pump shown at the right side of the reserve tank. Manifolded connections attach the reserve tank to the master pump system for a quick introduction of reserve fluid into the circulating system.

The mud pump manifold permits rebuilding the fluid volume in the reserve tank by mixing additional mud through the rig hopper. Fibrous material and water can be blended in the same manner.

By calibrating the reserve supply tank, the process of filling the hole on trips will become a more exact operation. The introduction of measured quantities of mud into the hole will assist in the prediction of lost returns or a potential blowout. Although the tank increases trucking requirements on a rig move, it is valuable on wells presenting difficult drilling problems.

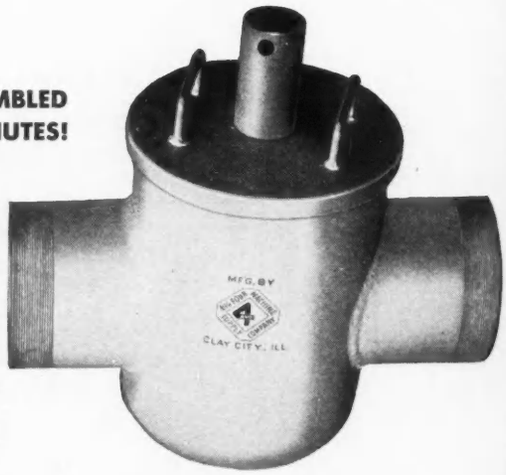

**The new . . . BIG FOUR STRAINER**

**Made to install on any pump or mud line.**

**CAN BE DISMANTLED, CLEANED AND REASSEMBLED IN LESS THAN 10 MINUTES!**

Big Four's new suction strainer was specifically designed to eliminate the lost time of drilling contractors in shutting down pumps to clean out leaves, sticks and other foreign matter from slush pits. It's efficient in operation, quickly dismantled, cleaned and reassembled.

The strainer is composed of only four parts—the screen easily removable by unscrewing nut, removing nut and cap from the body of the strainer. Screen is held in place by slot on each side of the strainer. Strainer cap has hydraulic packing to seal on body; nut has hydraulic packing to seal on cap. Length overall 26"; weight 200 lbs. Available in 4", 6⅝", 8⅝" and 10¾" sizes. Special sizes furnished to meet requirements.

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Type ES Series
for soft formations

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for medium hard formations

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— says Lester Sarratt, tool pusher for Crown Drilling Company, of Oklahoma City, drillers of sixty wells in the Golden Trend area of Garvin County, Oklahoma.

"For four years I have run CP bits at all depths and in all formations against every other type of bit, and their performance has reflected the fine engineering, skill and care that go into their construction."

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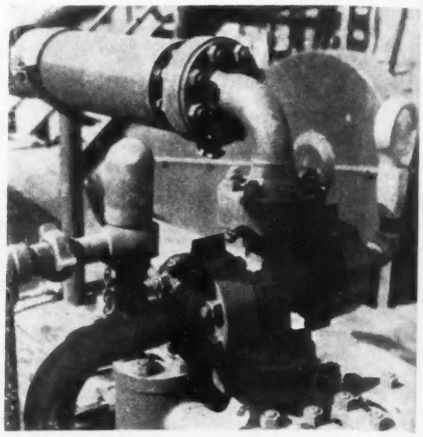
HOW TO—

## Protect Crew From Fluid Leak Injuries

To protect personnel from injury should a flange gasket or seal on a high pressure line fail due to misalignment, unequal tightening of bolts or sudden pressure surge, one company equips the more exposed flange installations with steel bands.

The band, which effectively breaks the force of a small, high-pressure stream that would shoot out if the seal were ruptured, is made of light sheet rolled to the diameter required to encircle the flange. Made in either one or two pieces, the unit is equipped with short ears which, when bolted together, enables the band to be drawn up tightly around the flange.

The installation represents little extra work or time when flanges, particularly those which are in exposed and in areas where men likely will be working, are installed or broken out. The bands provide an element of safety that is desirable on high pressure installations.



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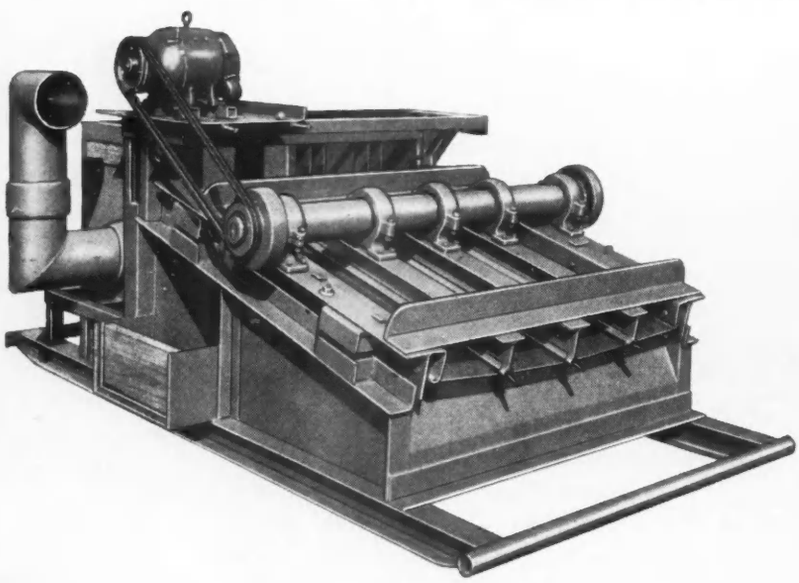
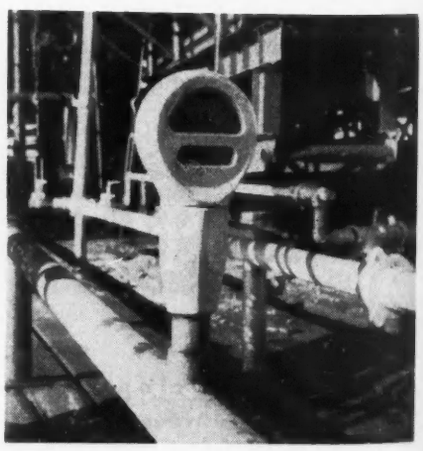


HOW TO—

## Install Mud Gauge Near Walk to Pump

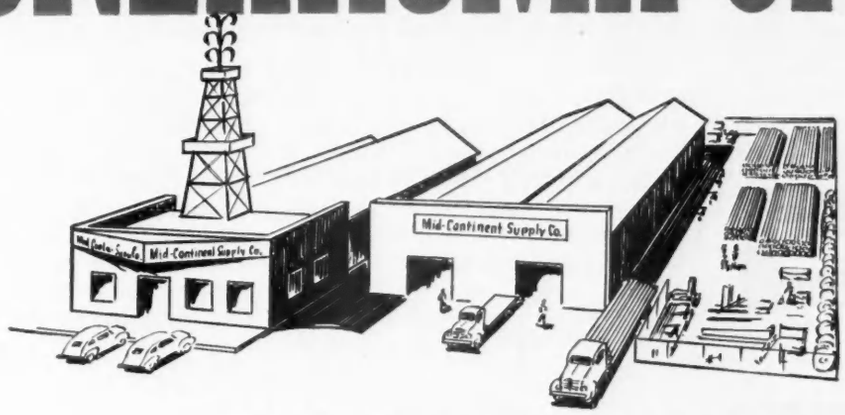
An auxiliary mud gauge alongside the walkway leading to the mud pumps will permit the derrickman to adjust pump pressures with greater convenience and accuracy. The conventional practice of installing mud gauges on the derrick floor only results in the necessity to relay messages from the driller to the derrickman for the proper adjustment of the mud pumps. In critical drilling operations, this practice can endanger a hole by introducing excessive circulating pressures conducive to breaking-down formations.

The mud gauge is attached by tapping the mud line and welding a two-inch collar in the opening. From this point, it is necessary only to attach a short nipple and the mud gauge.



# SYMBOL of SERVICE and SUPPLY in

# OKLAHOMA CITY

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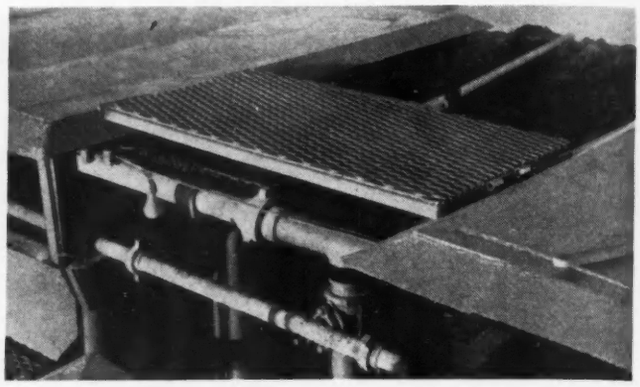
# HOW TO—Install Mud Tank Bridge



Covered mud tanks serve the dual purpose of sheltering the drilling fluid and providing a walkway when a bridge is installed between tanks. The installation eliminates the necessity of attaching walkways alongside the tank and permits more convenient operation of the mud guns.

Fabrication of the bridge includes welding a 1½-inch angle iron frame with one of the flanged sides facing up. To insure complete rigidity, an angle iron brace extends through the center of the frame. Heavy gauge expanded metal is tack welded atop the frame to provide a strong, non-skid walkway.

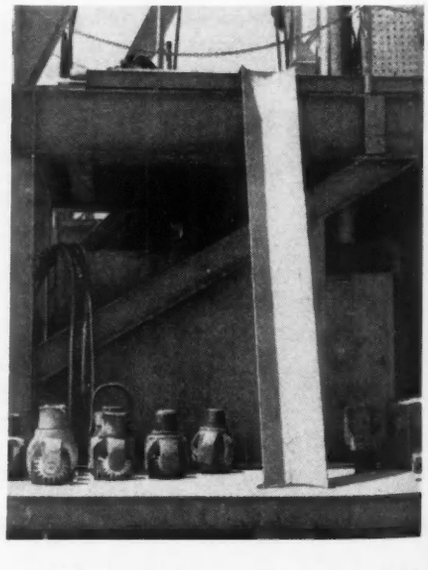
The walkway is attached to one tank by means of a rod and nipple hinge assembly. For rig transport, the hinge allows folding the walkway back to rest on the tank.

This sturdy walkway also serves as a spacer bar when spotting the tanks on location. By being permanently attached to one tank and with welded bead guides on the adjacent tank, the walkway makes the operation of spotting the tanks in the proper position less difficult.

# HOW TO—Build Chute for Tools

An aid to preserving the sharp cutting edges of rock bits is an inclined chute built from the derrick floor to a small dock installed at one corner of the drilling rig. The dock is an all-metal table with a large, substantial top supported by structural steel legs cross-braced to withstand heavy loads. The platform fits snugly against the sills and studding of the substructure and rests on a section of the timber mat designed to carry the load of the entire rig. This position at the side of the derrick is convenient to raise and lower bits, subs, and light equipment.

Using the conventional catline, the tools slide safely from the dock to the derrick floor in a large chute so that the teeth, threads and tool joints seats are never marred by striking sharp edges of sills and other structural parts of the rig. A small crescent-shaped depression is built into the top of the dock. The lower end of the chute is fitted into this slot to govern movement while in use. Since the distance from the top of the dock to the rig floor is always the same, the top of the chute is bolted at the upper end with a flange to prevent unnecessary movement when tools are being raised or lowered.



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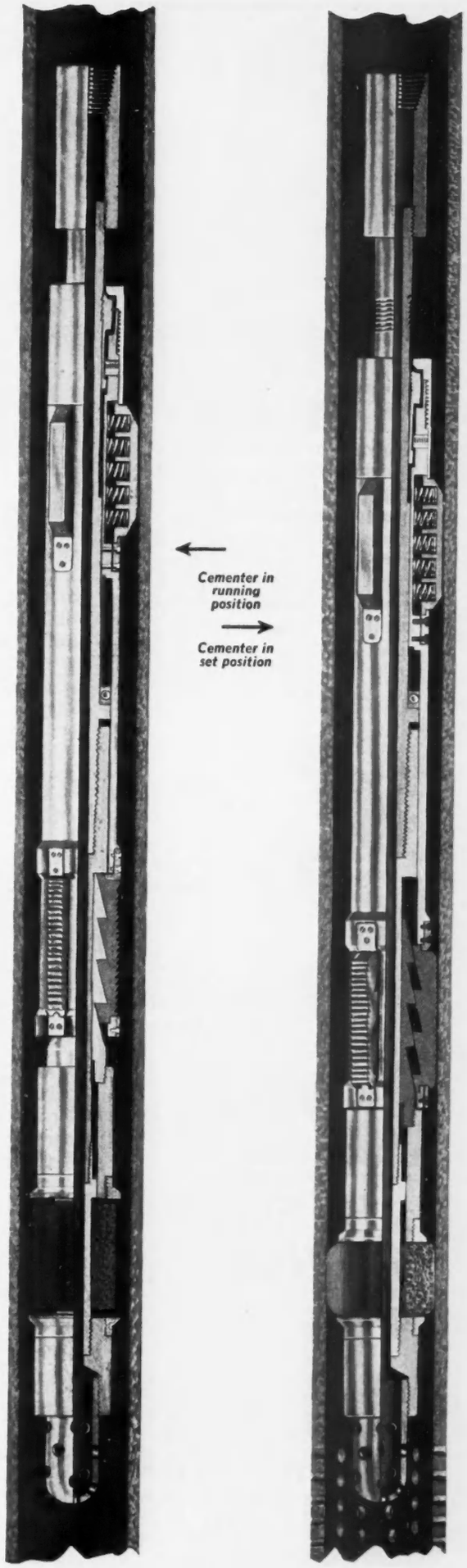

Cementer in running position

Cementer in set position

## runs in fast

You can get the Tri-State cementer down there in a hurry, and the tubing or drill pipe won't flow over at even a reasonably fast speed.

## holds tight

You can put the pressure to a Tri-State cementer—as much as the casing or tubing will stand—and it will hold tight.

## comes out easy

A simple slacking off of the tubing or drill pipe frees the Tri-State cementer. It can be reset as many times as necessary without pulling out of the hole.

The outside diameter is small enough that the tool can be washed over easily.

*Use Tri-State Oil Tool Services:*

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CUTTING — CEMENTING
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**4 Days or Less**

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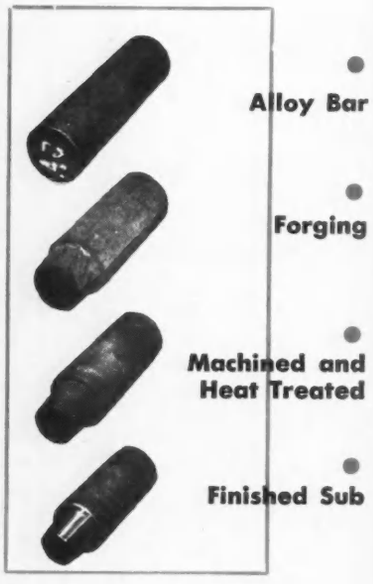


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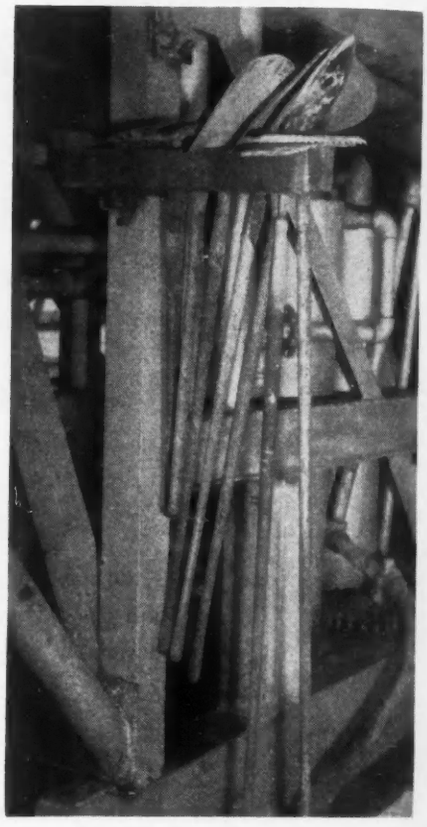
LONE STAR TOOL CO.

WICHITA FALLS, TEXAS




# HOW TO—Rack Shovels and Rakes

A simple, yet practical expedient for keeping track of picks, shovels and rakes—tools that are in almost constant demand around the rig site—is shown.



At any convenient, centralized point on the rig, preferably below and near the stairway leading up to the derrick floor, is mounted a rack consisting of a pair of 2x4's approximately three feet long. They are mounted parallel and far enough apart so that the handle of a rake or shovel can be inserted between them. Any convenient point on the rig substructure, or even a post driven in the ground, will serve as the rack support.

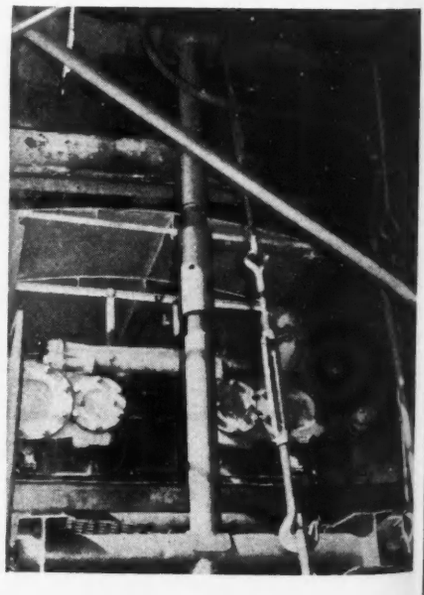
Once the crew becomes accustomed to the practice of returning tools to this one rack when a job is completed, far fewer tools will be lost, run over or otherwise damaged at each location. It is a relatively small housekeeping idea that, in time, will encourage the similar treatment of other tools around the rig. As a direct consequence, more frequent use of them, in keeping the yard area and rig facilities in clean and orderly shape, will be encouraged.

# HOW TO—Add Auxiliary Supports

Auxiliary support columns, tooled from drillpipe subs, can be used to advantage on marshy locations where heavy equipment is likely to settle. One operator constructed these support units of 4½-inch drill pipe with a spreader element working on flat, lathe cut threads. The spreader coupling is perforated in three different positions to permit rapid adjustment with a bar.

By equipping one end with a flat support and the remaining end with a round adapter, this equipment can be fitted flat against a beam or saddled on a piece of pipe. Both base adapters are fabricated of heavy sheet metal.

Since damaged drill pipe satisfies the construction requirements of the unit, the expense of building primarily involves welding and thread cutting operations. The unit is invaluable around a rig in case additional equipment support is required.



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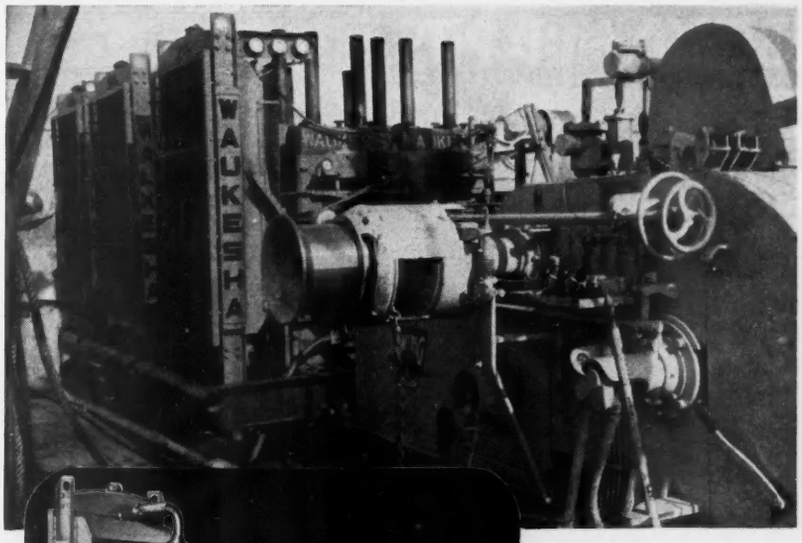
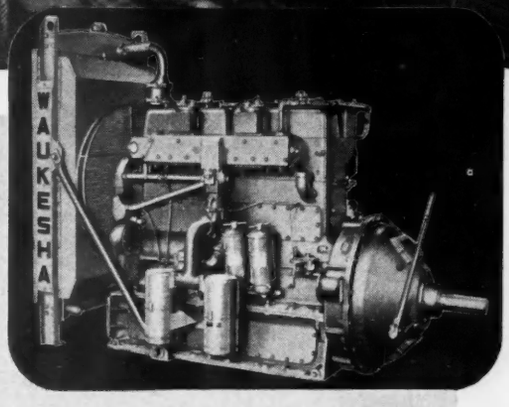
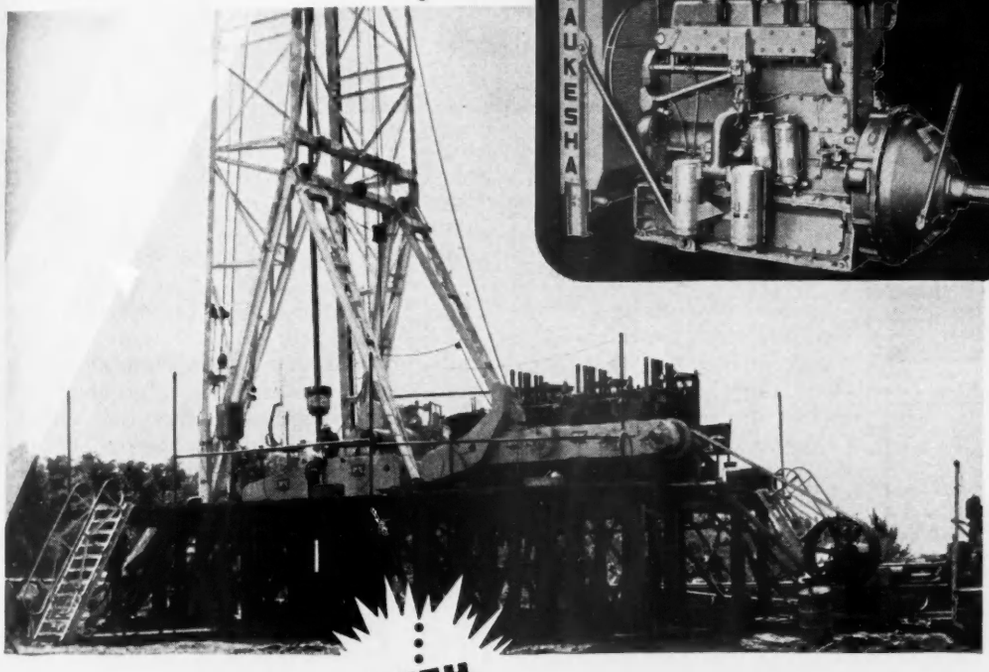



**WAUKESHA 6-NKU Oil Field Power Units** —six cylinders, 7-in. bore x 8½-in. stroke, 1962 cu. in. displ.; 225 peak hp at 1050 rpm, or 173 hp continuously at 950 rpm on natural gas or butane.



**Cushing, Oklahoma**—the **Unit Drilling Co.** is using **Unit-Rig** (upper and lower pictures) powered by three **Model 6-NKU Waukesha Oil Field Power Units** (shown in center picture).

WITH

# WAUKESHA

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If they didn't make more hole with Waukeshas, you wouldn't find so many of 'em all through the oil fields. Right here, the three Waukesha Gas Power Units are Model 6-NKU. The fast, flexible engine pours on the power—smoothly and dependably—the deeper the drilling. And it can take sudden, momentary overloads, without stalling. With its overhead valves and renewable wet sleeve cylinders, and all major parts easily accessible, it is simple and inexpensive to service. Effectively cooled by the large, separate radiator, and fan, as well as its jacketed exhaust outlets. It also has a 3¾-inch 7-bearing crankshaft, full floating piston pins and full pressure oiling. It's a great unit for well servicing or work-over duty, or any oil field or refinery service. Get Bulletins 1136 and 1122.

***Waukesha Engines and Power Units—15 hp. to 500 hp.—for every oil field service***

145

**WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.**

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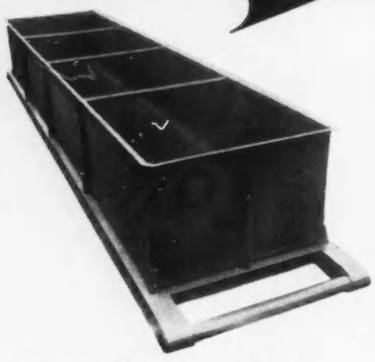
BEMCO MUD PITS



By now, most everyone realizes the advantages of portable steel mud pits. The only question remaining is "Where can I get the most pit for my money?"

**BUY BEMCO Mud Pits!**

There's your answer . . . and there are plenty of solid facts to back it up. BEMCO All-Steel Mud Pits are built to last longer . . . to give more features . . . to really give you more pit for your money.
Get full particulars on BEMCO Mud Pits now . . . and we believe that you too will say: "BEMCO Mud Pits are the answer!"

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# HOW TO—Reduce Mud Maintenance

Preventing earthen walls and dikes from sloughing in and making sure that cuttings-laden mud does not flow on over into the clean mud pit, are among the never-ending chores that must be attended to in the course of drilling a well.

Accomplishing these two things and at the same time reducing the amount of attention that must be paid to these operations, one drilling contractor has adopted a slightly different method of guiding the flow from one pit to another.

Instead of cutting a notch out of the soft and easily-caved fill dike which divides the two pits, a half-circle ditch is cut out of the virgin ground in the manner illustrated.

With this method the walls of the ditch are not likely to cave and depth of the ditch is controlled and known at all times. The gate that is dropped into place when flow between the two pits is halted is solidly anchored in the walls of the ditch, and, being at the edge of the pits, the ditch is more easily reached and tended by the man performing these chores.

The slight amount of work required to cut this circular ditch by hand is more than offset by the saving of time and labor that generally is required in keeping the soft earth partition and connecting ditch in good working order.

# HOW TO—Carry Fire Extinguisher

Foam type fire extinguishers can be stored and carried conveniently in a rack constructed of discarded ¾-inch pipe. Pipe handles are attached to the storage rack for ease of handling.

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# Production Section

J. E. KASTROP, SECTION EDITOR

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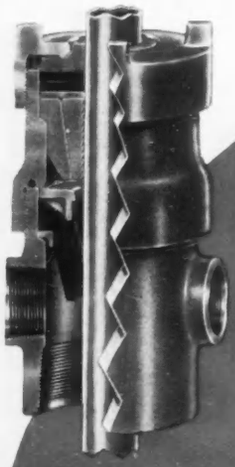
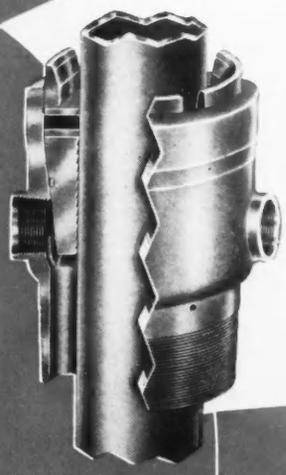


# Put these heads together



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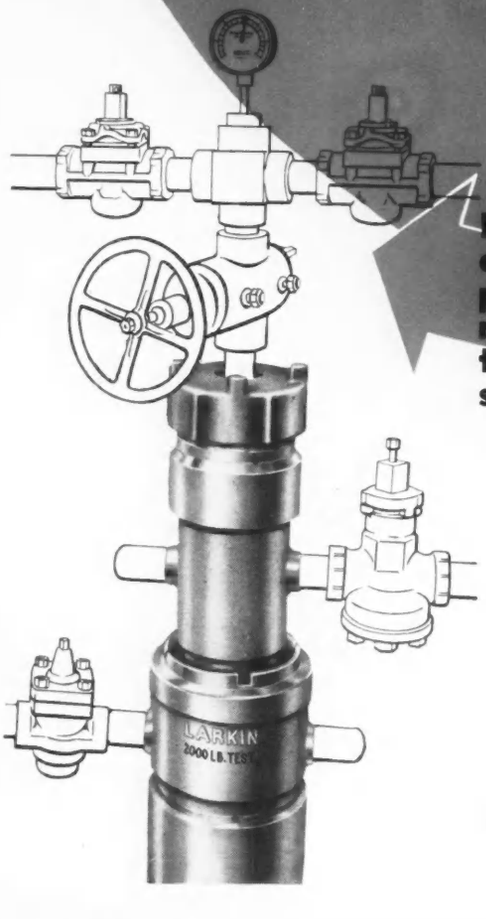


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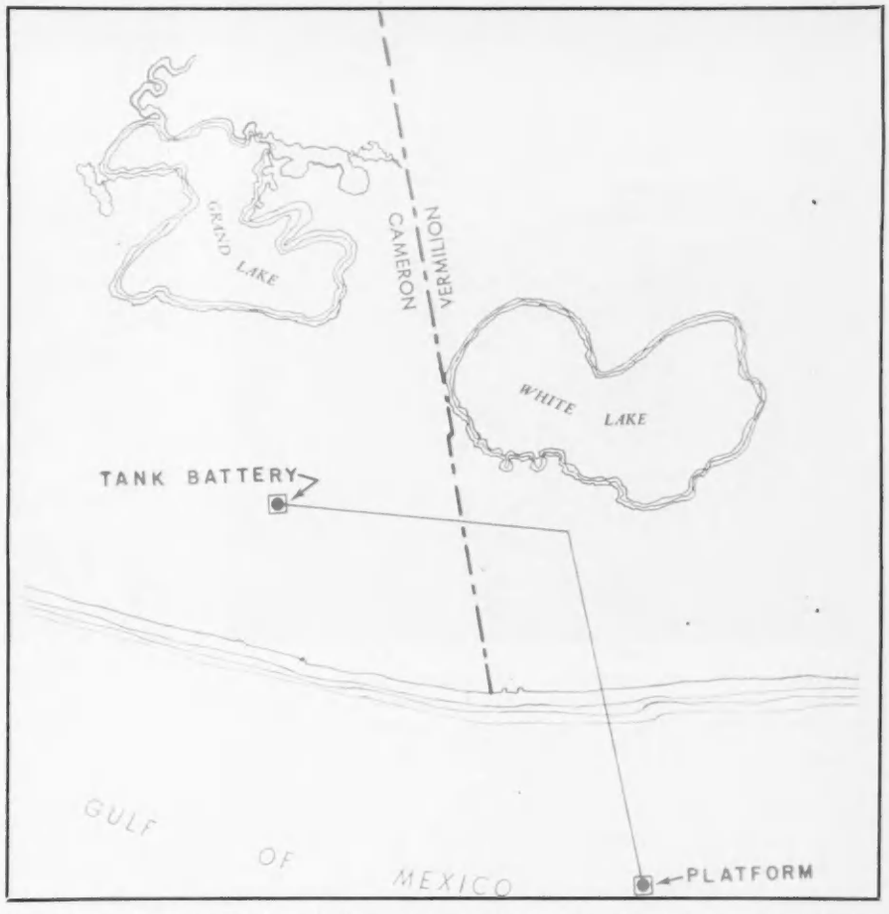
**PRODUCTION PROBLEMS** attendant to oil and gas fields located in the unprotected waters of the Gulf of Mexico are of major proportions. Transporting crude oil from these fields has been both expensive and uncertain. The production of gas-condensate fields located on shore is a major operation, and when the field is situated in 35 to 40 feet of water, the problem is multiplied. Here is the story of the first gas-condensate field to be produced efficiently and safely through an eight-inch submarine pipe line. How the problem was handled and the means for separating the gas and liquids for movement through the pipe line are described.

By GEORGE R. OLSEN

The Pure Oil Company
Houston




General location of the Rollover field in relation to the Louisiana Coast is shown in this map. Approximate location of submarine pipe line and shore line are indicated. A road terminates at the tank battery, from which the liquid distillate is trucked to sales points.

PURE OIL'S ROLLOVER FIELD . . .

# First Offshore Gas Condensate Production

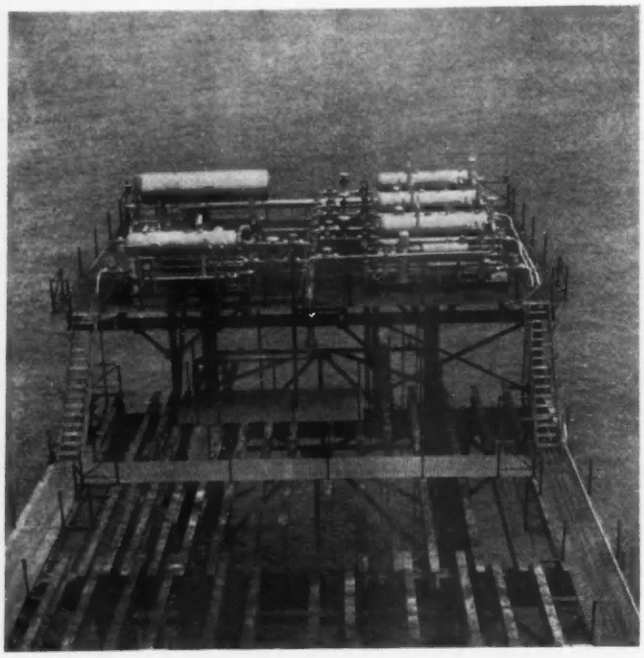
WITH the installation of production facilities in The Pure Oil Company's Rollover field off the coast of Louisiana, there has been made possible the utilization of millions of cubic feet of gas-condensate trapped below the Gulf's muddy bottom. A new type of gas separation equipment located on a specially constructed steel platform has been connected to the first "ocean-going" gas gathering line to transport the gas production ashore where it is picked up by a main trunk gas pipe line. This is the first time gas-condensate has been handled from an offshore structure through extraction equipment and piped ashore for commercial use.

The Rollover field consists of four gas-condensate wells, located on a steel piling platform in Block 39, approximately 8.3 miles from the nearest shore off Vermillion Parish, Louisiana. The all-steel platform is in water 40 feet deep where all four wells were directionally drilled. The discovery well was drilled in May, 1949. The wells were drilled by first driving 24-inch conductor pipe about 180 feet into the sea bottom. Approximately 600 feet of 16-inch pipe was followed by 3000 feet of 10¾-inch, and then about 9000 feet of seven-inch production casing was set. This pattern was followed in all wells with the exception of the discovery, in which the sizes were slightly smaller. A production string of three-inch tubing was set with a packer near the bottom of the well. All wells were completed in the Miocene formation to a true vertical depth of about 7600 feet.

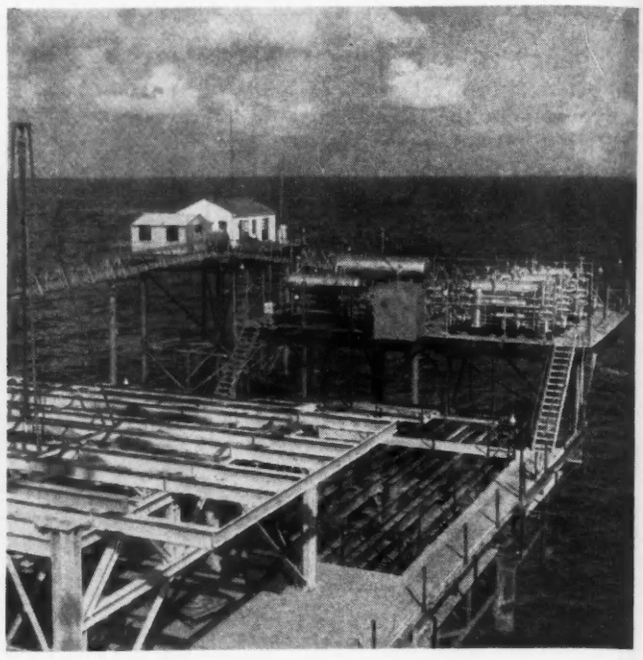
Production of the gas-condensate wells presented many problems not normally encountered in onshore work. Transportation of the gas and distillate to shore, the small and confined area upon which to install the production equipment, and the major item of safe production were a few of the difficult problems which had to be carefully considered.

A contract was made to sell the gas, and the contracting company laid a submarine gas pipe line. The line has an outside diameter of 8⅝ inches with a weight of 38 pounds per foot, and is about 8.8 miles long from the shore to the platform. It was coated, wrapped and laid 4 to 6 feet below the mud bottom to protect it from marine growth. Another connecting line, 18.5 miles long, was laid from the shore point, through the swamp, and to the end of Tiger Island ridge where the first solid ground was reached.

This pipe line solved the gas trans-



This photograph, taken before the living quarters platform was constructed, shows the location of the four low temperature separators and the skimming tank (left background). Eight-inch pipe line to shore is beneath separator platform.



Partial view of platforms in the Rollover field, showing living quarters recently erected, separator platform at upper right and drilling platform. Producing wells are beneath drilling substructure shown in the lower left of photograph.

portation problem, but since the line was buried in the relatively cold waters of the Gulf and due to the low temperature of the swamp land in the winter months, the gas had to have a sufficiently low water content to prevent the formation of hydrates which would plug the line. This difficulty brought on the investigation of all types of production equipment to determine which could be best adapted to fit the particular conditions involved.

A rigid set of conditions was set forth with the hope that all of them could be met by one type of equipment. The list was broken down as follows:

- The equipment had to take full well shutin pressure of about 3000 pounds per square inch gauge and step it down to 1200 psig for injection into the submarine pipe line.
- The gas had to be processed so it did not contain more than 14 pounds of water per million cubic feet of gas, but the desired quantity was to be less than seven pounds of water per million cubic feet of gas.
- To separate from the gas a maximum amount of distillate and free water.
- Each well had to have its own production equipment so it had to be of minimum size, and still have a minimum individual capacity of 10 million cubic feet per day.
- The equipment had to have added safety equipment, which would be automatic to shut in all wells in the event of some disturbance in the normal operating conditions.

An additional separator platform 35 feet by 50 feet was built adjacent to the existing drilling platform, since the drilling platform had to be left free of equipment for the possibility of a future workover rig. Figure 1 shows the platform arrangement at the present time, including the isolated living quarters platform for personnel safety. Since the platform was small and near the wells, the use of any type of gas-fired equipment was considered inadvisable. This hazard eliminated the use of high-pressure heaters and separators, chemical absorbants or refrigerants where gas-fired equipment is required. The use of antifreezes such as glycol for injection into the gas stream was considered, but proved impractical, because the recovery plant would have to be ashore and the recovered chemical would have to be transported 38 miles to the docking point at Cameron, La., and then delivered 56 miles by boat to the platform. The elimination of the above equipment narrowed the list to some type of mechanical separation.

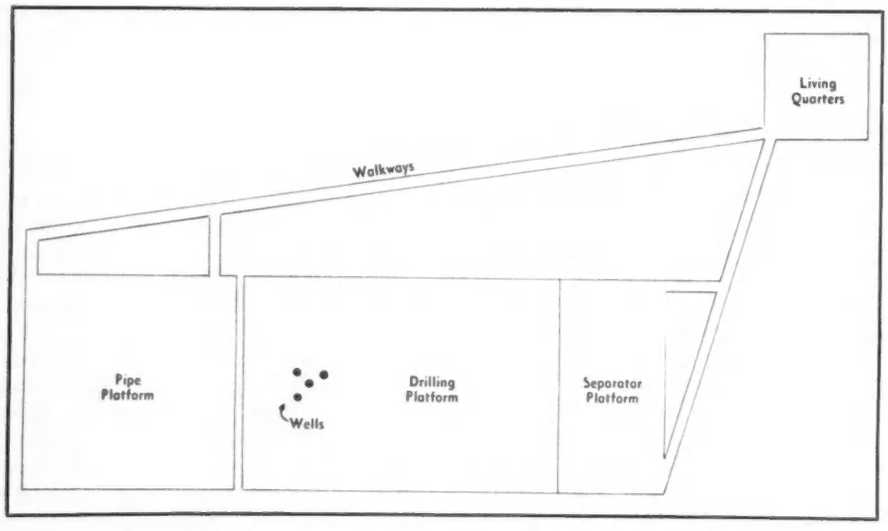



FIGURE 1. General layout of offshore structures in the Rollover field.

## Field Tests

In the summer of 1950, extensive tests were made with low temperature separation equipment which appeared to offer the most in mechanical separation. At that time this equipment seemed to fit most of the needs of pro-

ducing the offshore gas-condensate wells, since the equipment utilizes the well stream heat to melt the hydrates formed after the gas has been choked down. The tests were made not only to compare the low temperature units with the standard high-pressure heater and three-stage separation equipment, but to gain all the knowledge on the best design of low temperature separation units to meet the needs for possible offshore equipment.

There were three major phases of testing to obtain all possible data. The first consisted of operating the high-pressure gas-fired heater with a choke along with the three-stage separator setup. The second and comparison phase was carried out by operating the low-temperature separation unit in separating the gas, distillate and free water. The distillate was staged down exactly under the same conditions as had been done in the previous tests. The third phase was duplicating the second phase, and the gas and distillate were recombined as they left the unit. The recombined stream was heated by an indirect heater to various temperatures and then the recombined stream was separated and again the distillate was staged to stock tank conditions. These comparison tests were run repeatedly to be certain of the data obtained. The low-temperature unit was also operated at various flow rates and pressures to obtain as wide a scope of data as possible.

Important advantages of the low temperature unit were that the stock tank liquid recovery was appreciably increased and the dew point of the gas was decreased to well below seven pounds of water per million cubic feet of gas so long as the temperature of the gas entering the choke was correctly controlled.

With data and experience obtained from these field tests, it was decided that the use of low-temperature separation units would best satisfy the particular offshore conditions with a few design changes and additions. In other words, the units would satisfactorily separate the gas, and extract the maximum amount of distillate and free water. The gas and distillate were recombined for transportation ashore and then re-separated. By recombining the gas and distillate, the need of storage tanks on the platform and barge facilities were eliminated along with a potential fire hazard. Three-stage separators and stock tanks were required on the shore plant site. The distillate was transported from the plant by truck.

The next step included designing the units to fit on the small separator platform and still meet the following conditions:

- A minimum capacity of 10 million cubic feet of gas per day.
- The pressure ratings of the units were to be 3000 psig upstream of the choke, which is full well shutin pressure, and 1500 psig downstream of the choke.
- The unit had to have a sufficiently large heat exchanger to insure proper temperature control of the gas for maximum dehydration.
- The units had to be very compact and complete with a mud or sand trap along with gas and distillate meter runs.

### Separator Operation

The full well stream enters the high-pressure scrubber or trap as shown in Figure 2 where heavy foreign material such as sand or mud is removed to prevent clogging the rest of the equipment. This trap is important because if the mud was allowed to pass into the coils and heat exchangers, the heat transfer efficiency would be greatly decreased and the units would not operate correctly. The foreign material in the scrubber is removed by opening a double-valve blowdown near the bottom of the vessel and the full well pressure forces the material out of the unit. The double-valve arrangement is to insure that one valve will always be a positive shutoff since it is always fully opened or shut, never throttling the abrasive material through the valve.

As shown in the diagram, the outlet from the scrubber is below the inlet. This design feature permits the condensed liquid to pass with the gas into the high-pressure free liquid knockout where, just as the name implies, the free liquid is removed. By removing this liquid ahead of the coils and heat exchangers the efficiency of both will be greater since the liquids have

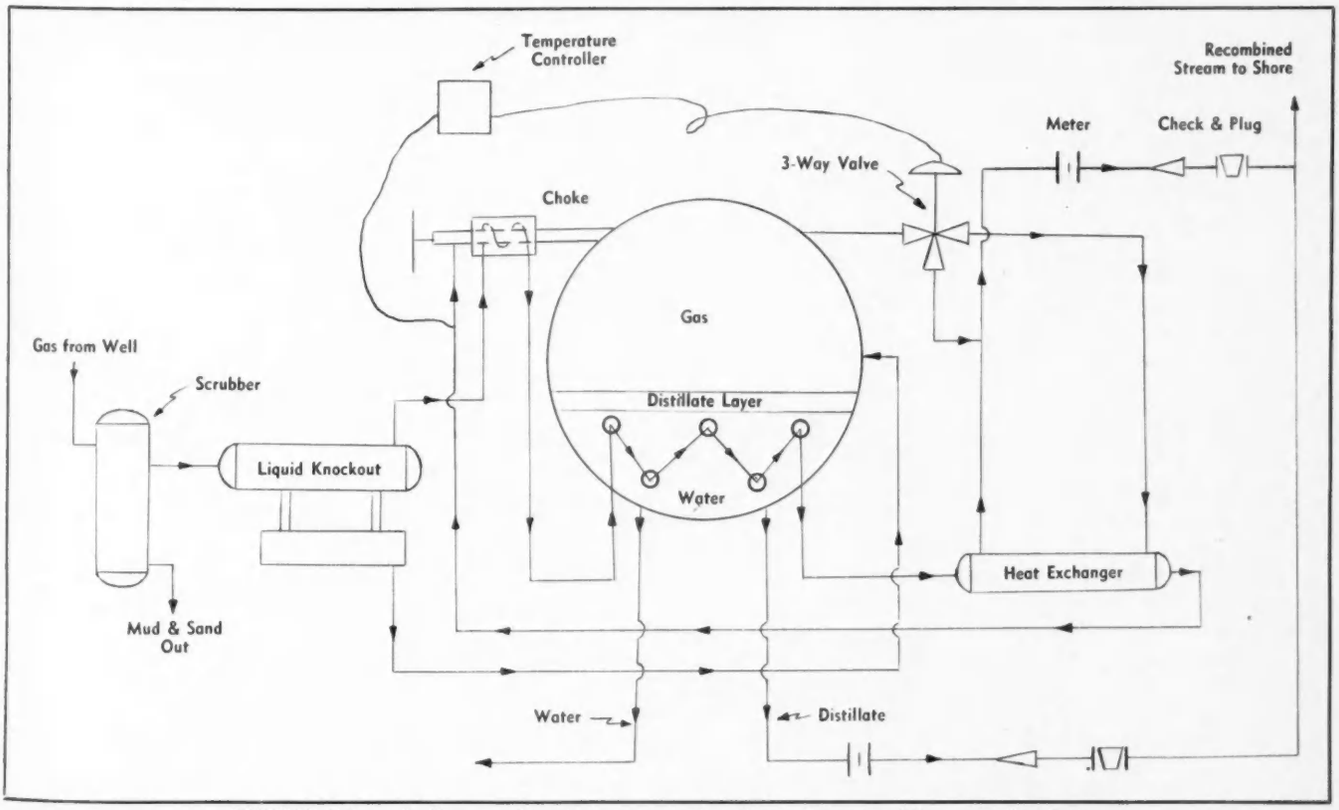
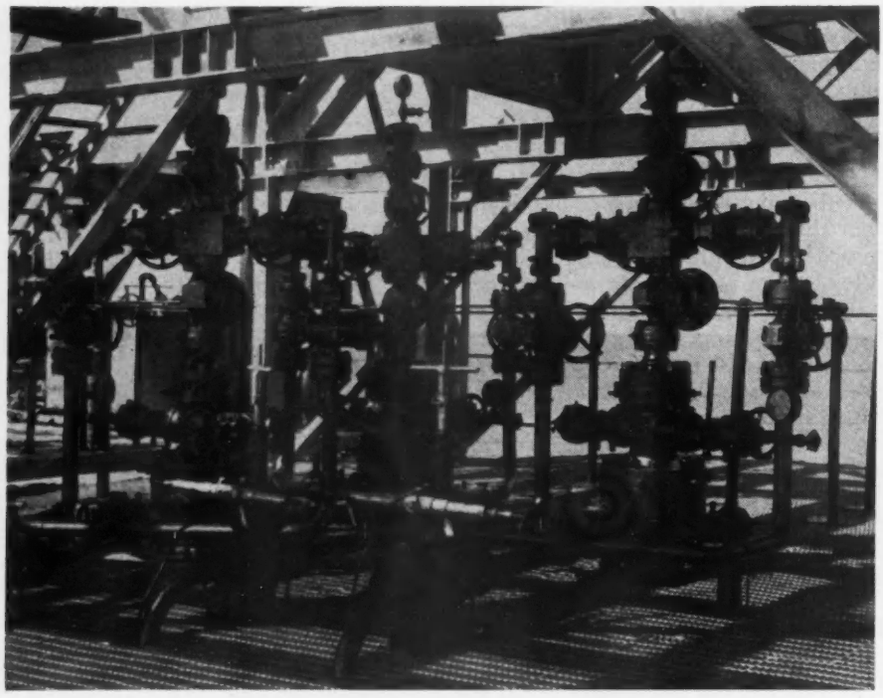



**FIGURE 2. Schematic diagram of low temperature extraction equipment and free water knockout.**



**Three of the four producing wells equipped with double-winged christmas tree and flow line safety valves for each flow line to the separator platform.**

greater film coefficients and thus the heat transfer would be reduced. The liquid that condenses out of the gas when cooled is not of sufficient quantity to be a great detriment in this particular installation. Liquid from the free liquid knockout is removed at a constant rate to the low-pressure vessel as shown.

### Heat Transfer

Liquid-free gas from the top of the knockout passes around the jacketed choke and then flows into the coils in the main separator. At this point the important well heat is given up to the water which covers the coils to melt the hydrates by heat transfer. The gas then leaves the coils with its temperature lowered, but not sufficiently low for the most efficient operation, so it enters the five-pass heat exchanger section for further cooling. These heat exchangers are of the bundle tube type which give the maximum area in the least amount of space. The warm, high-pressure gas passes through the inside of the tubes and is cooled by the cold low-pressure gas which flows in the opposite direction around the outside of the tubes.

Temperature of the high-pressure gas leaving the heat exchangers affects a temperature controller which in turn actuates a three-way valve to put the required amount of cold low-pressure gas through the heat exchangers. Thus, if the high-pressure gas leaves the heat exchangers at a temperature higher than that value set on the controller, the three-way valve is actuated and allows more cold, low-pressure gas to enter the heat exchange section, thereby cooling the high-pressure gas down to the control point. The heat exchanger is one of the most important pieces of equipment along with a sensitive controller, since the entire unit operation depends upon temperature control. If the gas is not cooled sufficiently before entering the choke, the gas will not be fully dehydrated. In this particular installation, for every additional degree the gas is cooled ahead of the choke, the temperature downstream of the choke will be two degrees colder. The gas may only be cooled to one or two degrees above the hydrate point ahead of the choke.

It must be remembered that up to this choke, full well pressure has been exerted on the equipment. The gas is choked from about 3000 to 1200 psig and the hydrates formed fall into the liquid section. This liquid section consists of a few inches of distillate on top of the water section with the water completely covering the coils. The hydrates, most of which are water, are melted in the liquid section by the well heat given up through the coils. The water and distillate separate due to the differences in specific gravities. Gas leaves the separator at a point about two-thirds the length of the separator from where it first entered through the choke and either goes through the heat exchanger or is by-passed as dictated by the temperature controller and the three-way valve. The gas is metered and put into the common manifold, and finally enters the pipe line.

The distillate and water in the separator are separated by a baffling arrangement and the two are removed separately with the distillate being recombined with the gas. In order to assure recombination of the gas with the distillate, pressure drops were built into the unit so the gas would have a lower pressure when it reached the manifold. In addition to the pressure drop, the distillate has a fluid head to facilitate recombining it with the gas.

One important design feature involves keeping the distillate cold, because the nature of distillate is such that its absorption of water increases rapidly with slight increases in temperature. Since the products are recombined, water in the distillate must be held to a minimum or the gas will absorb the water. For this reason, as previously mentioned, the coils are completely covered by the water, thereby insuring that the distillate will be kept cold and thus preventing

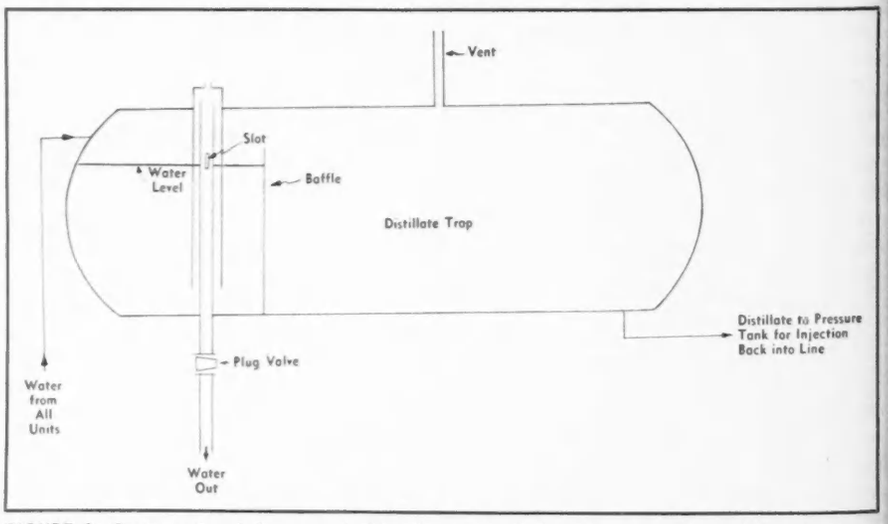



**FIGURE 3. Cross-sectional diagram of skimming tank which takes water from all low temperature units.**

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it from absorbing water. By keeping the distillate layer thin, the length of time it remains in the separator will be very short which will aid in keeping the distillate cold. Further, the unit has provisions for maintaining the layer of water covering the coils regardless of what may happen to the control equipment.

Water is removed from each unit and placed in a skimmer tank serving all units. A sketch of the skimmer is shown in Figure 3. This skimmer tank is a secondary precaution to insure that the water removed from the units is distillate-free before disposing of the water. This tank has a mechanical syphon drain with baffled section for trapping any distillate that may be accumulated. The distillate is removed by gravity flow into a pressure vessel and lubricated into the line.

### Safety Measures

Safety equipment begins in the tubing where storm chokes are set, so that in the event a rupture of the christmas tree occurs, the differential through the choke becomes greater than a predetermined value, the choke will close. In the event of an approaching hurricane, the wells are shut in and a provision has been made to set a blanking plug in the tubing above the storm choke, thus giving positive shutoff of the well and thereby doubling protection.

Another important device is a safety valve in the flow line near the christmas tree. This valve "feels" the pressure both upstream and downstream of the choke, so that by setting the desired shutoff conditions, it protects the equipment as follows:

- Any rupture upstream of the choke, whether in the flow line or in the high pressure equipment, the valve will close.
- A rupture downstream of the choke will close the valve. Of course, the farther the rupture occurs from the choke such as in the pipe line going to shore, the longer the time lag before the valve "feels" the pressure drop and closes.
- A pressure buildup over the rated working pressure of the unit will close the valve. Once the valve closes, it must be manually opened. This feature is desirable since the cause for closing the valve must be remedied before the valve is put back into service.

An additional safety feature has been adapted in conjunction with the flow line safety valves. All the valves may be shut off at once from various stations spotted at strategic points on each platform and walkway. Safety valves are connected to a common vent line with vent valves connected into the line, so that if some disturbance occurs, the operating personenl may open any one of the valves on the vent line and thereby close the flow line safety valves.

There is also a system for closing the master valves on the christmas trees and a valve on the pipe line. These valves are closed by nitrogen-actuated pneumatic motors, and as with the flow line valves, control points are situated throughout the various platforms and walkways.

The separation units are also equipped with bursting heads, pop valves and check valves to give added protection in the event the other safety equipment fails to operate. Each unit may be completely isolated from others in the system for maintenance work.

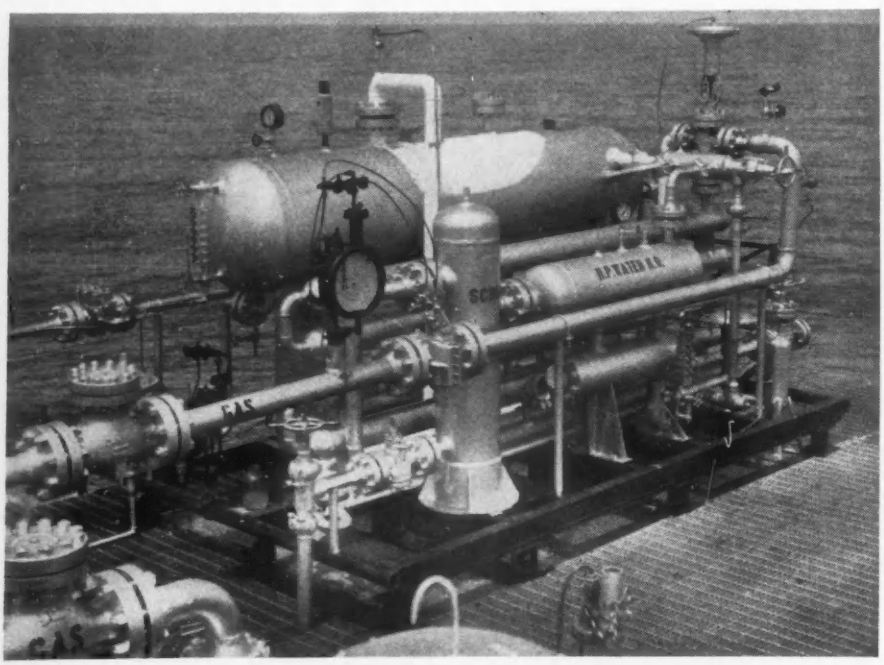
As shown in the photographs, the well and separator areas and connecting walkways are covered with steel grating. Grating prevents the accumulation of inflammable liquids as would be the case with a wood decking. Thus, the all-steel construction reduces fire hazard.

The first gas began flowing through the pipe line in April, 1951, with the units performing satisfactorily. Separation is very efficient and the gas has a remarkably low water content of about 4 pounds per million cubic feet of gas.

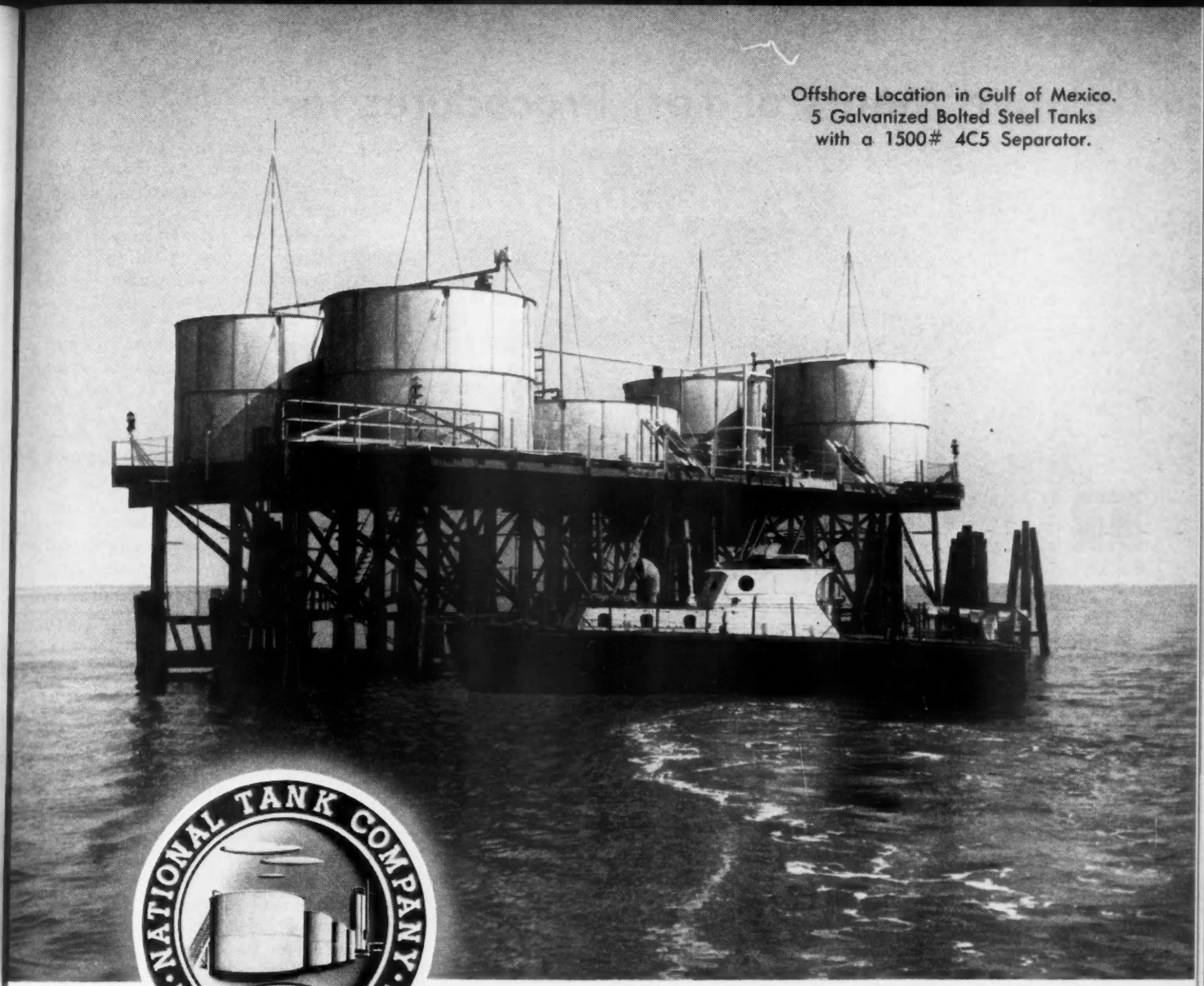
In years to come, there will undoubtedly be discovered numerous gas-condensate fields in the Gulf of Mexico. While their problems may not be the same as those encountered in the Rollover field, they will be similar in nature. What has been accomplished at Rollover may offer a solution or point the way for a practical approach to economically producing gas-condensate fields, that in the early stages of offshore development were a liability to the operator.

## About the Author

GEORGE R. (RAY) OLSEN was born in New York City. His studies in chemical engineering at Purdue University were interrupted by three years service as a pilot in the U. S. Army Air Corps. He returned to Purdue and obtained his B.S. degree in chemical engineering in 1948. For 1½ years after graduation, he worked for Creole Petroleum Company, part of the time in Venezuela. In January, 1950, he was employed by The Pure Oil Company, and in April was moved to the company's Production Engineering department in the Gulf Coast division office at Houston. He has devoted much of his time to low temperature separation and its application to gas-condensate production problems.



**Closeup of one of the four low temperature extraction units. Note part of the separator and gas line leaving the separator are coated with ice caused by the cold gas.**



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# Relative Merits of Test Procedures for Natural Gas Wells

By C. H. HINTON

Panhandle Eastern Pipe Line Company, Liberal, Kansas

THE CURRENT and continued producing capacity of a natural gas well is the backbone of the natural gas industry. The accurate determination of the producing capacity of a natural gas well has posed a problem for the operators and the petroleum engineers since the early stages of the natural gas business. Prior to the time of long distance pipe lines, the producing capacity of a gas well was not so important as today. The cities that enjoyed natural gas as fuel were usually located near a producing field and the investment required in transporting the natural gas did not require major capital expenditures.

In the early days there was little uniformity in test procedure or methods of testing, and the comparison of various reports did not provide dependable information on which either continued supply or reasonable financing could be based. As the natural gas industry increased in scope, well testing became increasingly important.

The pitot tube well test became almost universally accepted several years ago. The pitot-type test required that the well be opened to atmosphere and the gas flared for varying periods of time. The fact that stabilization of flow conditions was rarely reached did not greatly influence the acceptance of the tests. The information obtained from this type of test was of only mediocre value and did not furnish dependable operating data to evaluate the availability of gas down through the years or the working pressures which would prevail when required volumes were being produced. Inasmuch as stabilized flow conditions were obtained from a minimum of a few minutes to many hours, such reports including open-flow data as were published widely and often employed as a basis for financing, were actually of slight value.

In the late 1920's, when long distance pipe line programs were commenced, the testing of natural gas wells assumed added importance. However, the estimated natural gas reserve at that time was so far in excess of market requirements that many pipe lines were constructed without the control of adequate reserves, as it was assumed that additional gas could be acquired as needed.

It was during this period that the Bureau of Mines assigned E. L. Rollins and M. A. Shellhardt, engineers, to study natural gas well testing. The result of this important work was the development of the back-pressure open-flow test. This work can be considered as the greatest step forward in gas well testing to that date. Monograph 7 was published by the U. S. Department of the Interior and became almost a universal text book on gas well testing.

Experience revealed that this type of test for a natural gas well had three principal disadvantages:

- The number of man hours involved in making this type of test.
- The volume of gas which was blown to the air and wasted, particularly in the reservoirs of lower pressures.
- The lack of a proper friction factor on vertical flows that covered all the rates of flow in the various size producing strings.

**DELIVERABILITY TEST calculations on a hypothetical gas well show there is a wide variation in calculated flow due to the method of determining the friction factor. The author shows results on log-log graph paper that are based on calculations using the Weymouth formula friction factor, and friction factors as determined by Cullender and Binckley for three wells of different casing sizes.**

While the back-pressure method of testing resulted in large volumes being blown to the air, it did furnish desirable operating data. It was one of the important steps forward in the testing of gas wells and, in the high permeability reservoirs, did not create a heavy burden on the operators. However, it soon developed that the use of this type of test in a low permeability reservoir with low pressure required long lengths of flow to establish stabilized flow conditions, and accordingly, resulted in a higher gas wastage and man hour requirements.

The next step forward in the method of testing natural gas wells was born as a result of proration hearings held on the Kansas portion of Hugoton field. After many lengthy proration hearings in the early stages of trying to prorate the Hugoton field, and after listening to many and varied arguments of numerous lawyers, it developed that consideration must be given to the following five dimensions:

(1) Lineal surface or acreage.
(2) Thickness of effective pay.
(3) Effective porosity.
(4) Reservoir pressure.
(5) Time.

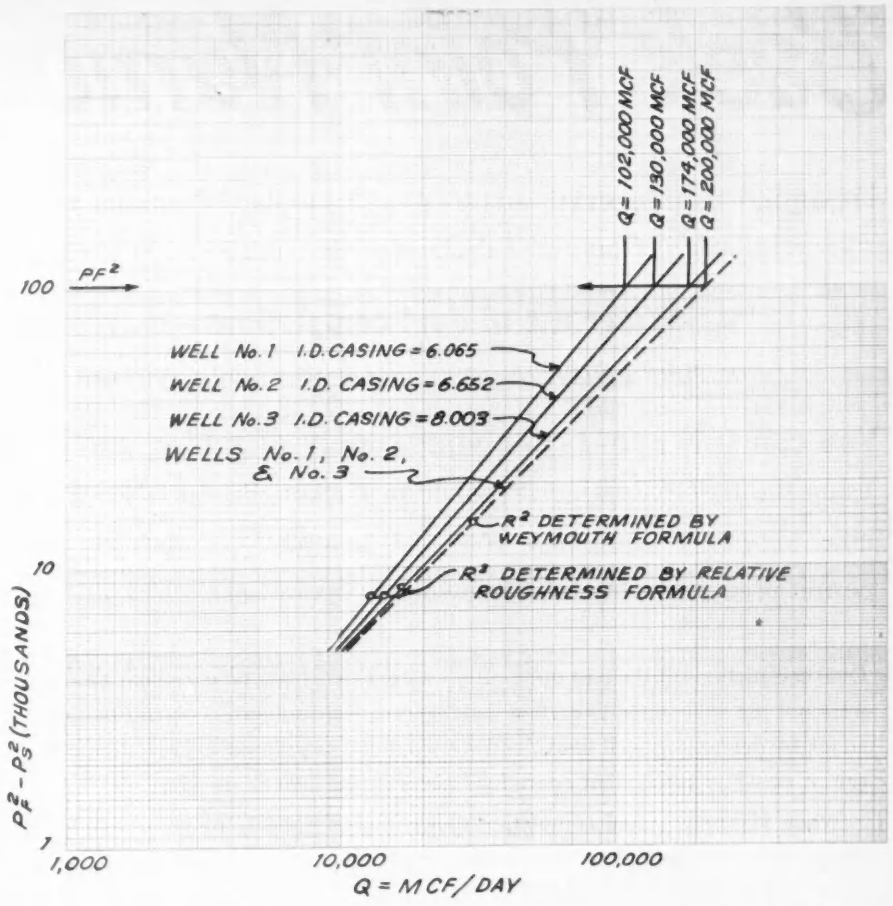
About the time these hearings commenced, the Kansas State Geological Survey requested that sufficient gas wells be made available to run a series of back-pressure open-flow tests as developed by the Bureau of Mines. It soon became apparent that the length of time required to reach complete stabilization in the Hugoton field was prohibitive in both man-hour requirements and gas waste. However, this testing program was carried on for several months thereafter but was discontinued when landowners objected to the waste of gas. These tests did furnish enough information to obtain some desirable data, and it was at this time that the taking of deliverability tests through meter into pipe

lines against varied working pressures was commenced.

Operating companies in the field had a wide variation in working pressures in their respective gathering lines, and inasmuch as back-pressure test points which were taken at low rates of flow rarely appeared to be dependable, it was suggested that a pull-down pressure be obtained as low as gathering system pressures would permit. In order to arrive at a uniform well evaluation and in order to establish as nearly uniform pressures over the field as possible, it was recommended to the Kansas Corporation Commission that all wells be tested through existing pipe lines and meters so as to produce a working pressure as close as possible to 80 percent of the arithmetical field average of the 72-hour closed-in pressures. The Commission adopted this recommendation and it has been in successful operation since 1943 in the Kansas-Hugoton field and shortly after was adopted by the Oklahoma Corporation Commission in the Oklahoma-Hugoton field.

The Texas Railroad Commission has adopted the deliverability type test in the Texas portion of Hugoton field on an individual well rather than upon a field average pressure basis. No gas loss results from this type of test.

In the Panhandle field, potentials have been obtained over the past two years by a one point deliverability test, while gas is being produced into the gathering system, and utilization of previously obtained data. The major problem which remains to be corrected in the deliverability type test is the adoption of uniform friction factors for production strings on large capacity wells. Considerable work is now being done to correct this condition. It is believed that the past few years have seen a wide advancement in gas well testing.




**Comparison of back pressure open flow tests—friction factor calculated by Weymouth formula and Relative Roughness formula.**

### Friction Factors

Calculation of the back-pressure open-flow in concurrence with Monograph 7 is satisfactory for most wells. However, when potentials of wells of large capacities are calculated, the results are obviously erroneous. These errors are not necessarily inherent of the back-pressure test but are caused by the use of incorrect friction factors. The friction factors are calculated from the Weymouth Formula and become more inaccurate as the diameter of the pipe decreases.

M. H. Cullender and C. W. Binckley have adapted the coefficient of friction, as determined by the relative roughness of pipe, to the vertical flow of natural gas in gas well casings. Relative roughness is the ratio of the absolute roughness of the internal surface of the pipe to the internal diameter of the pipe.

Both of these methods of calculating back-pressure tests are similar. In each case $P_s^2 = e^s P_w^2 + R^2$; where $P_s$ = sand face pressure and $P_w$ = wellhead pressure. In Monograph 7, $R^2$ is determined by the use of the Weymouth Formula. The Weymouth Formula determines $R^2$'s greater than the actual value. In some cases, because of the excessive $R^2$ value, the calculated $P_s^2$ is greater than $P_f^2$ ($P_f$ = the shutin formation pressure). This is an obvious impossibility as it indicates a negative pressure drop from the reservoir to the well bore, thereby resulting in a calculated potential of infinite value. While only a few wells are affected to this extent, all large wells with small diameter casing, seven inches or under, have calculated potentials which are considerably greater than the actual potentials.

The accompanying graph shows a comparison of three hypothetical wells with different size casings. All three wells show a potential of 200 million cubic feet per day when calculated using the Weymouth Formula. When $R^2$ is calculated by the coefficient of friction, determined by the relative roughness of the casing, three different potentials are obtained, varying in magnitude according to the casing diameter.

The Railroad Commission of Texas is now adopting the Cullender and Binckley method for the determination of the friction factor in back pressure open flow calculations. While these calculated potentials appear to more nearly approach the actual field conditions and thereby assign a more nearly equitable comparative potential to each well, particularly those wells that have large diameter casing in them, the Binckley friction factor is a new development and remains to be proven as an accurate, workable factor.

The problem of friction factors will undoubtedly require much more work. The interest which has been created in this phase of gas well testing will ultimately be solved by the combined efforts of the U. S. Bureau of Mines, engineers representing state regulatory bodies, and the oil and gas industry.

If the pitot tube method of testing were still in effect in the Hugoton

■ CONTINUED ON PAGE 192

# Back "Point Number 4" with

**Designed to conserve** and to stretch supplies of tubular goods, Point No. 4 of P.A.D.'s "Four Point Oil Country Tubular Goods Conservation Program" reads as follows:

> **"4—Wider use of dual completions** —*the practice of tapping two or more petroleum reservoirs with a single well bore."*

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The Baker Retainer Production Packer is truly revolutionary because, when set, it *virtually becomes a part of the casing,* leaving the tubing string *free for running in* or for *removal from the well,* meanwhile maintaining complete isolation of the producing zones.

The Baker Retainer Production Packer can be set safely and accurately on tubing or drill pipe, but to save wear and tear on precious tubular goods, we recommend setting on an electrical conductor cable by one of the leading wire line service organizations. After reviewing the two dual completion installations on the opposite page, we suggest that you contact the nearest Baker representative for helpful, profitable recommendations. —Then, by selecting the required Baker Packer Accessory Equipment, your specific "dual zone" or single-zone production requirements will be readily met.

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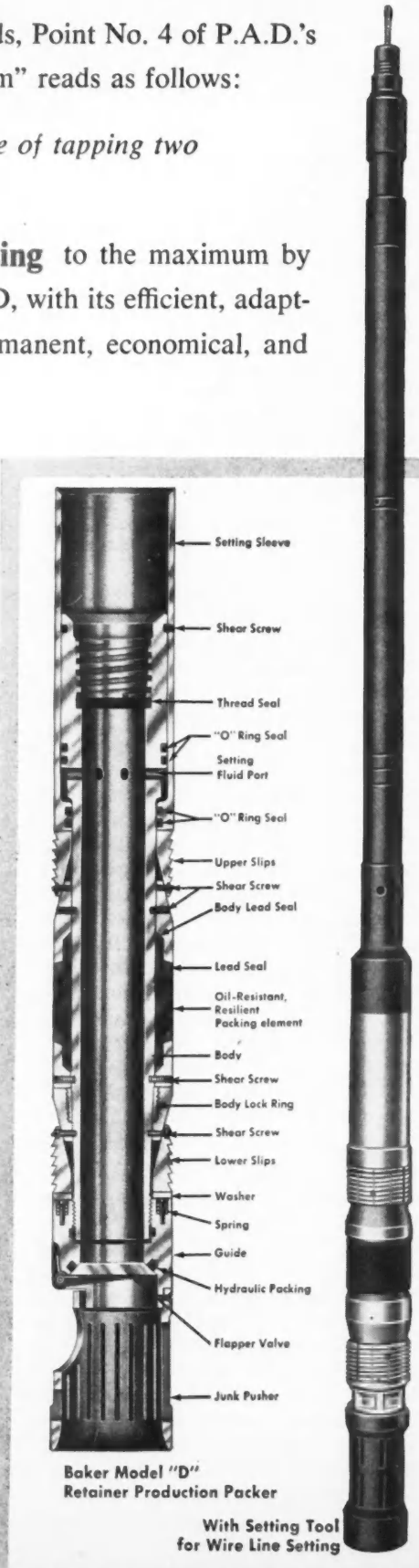


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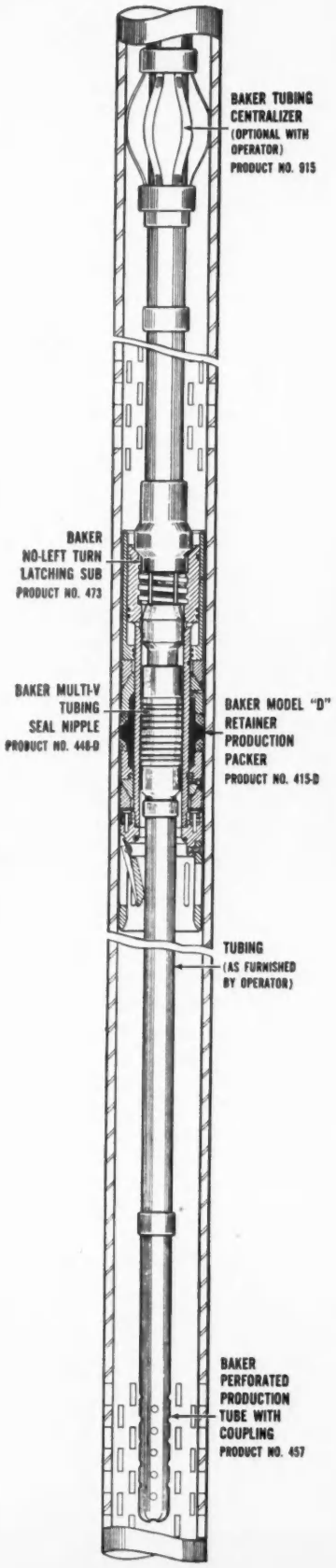
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## HERE ARE A COUPLE OF GOOD EXAMPLES OF MODERN DUAL COMPLETION INSTALLATIONS...

**LEFT**—This *one-packer* hook-up provides a means of producing two zones at the same time, the *lower* zone being produced through the tubing, and the *upper* zone through the annulus between the tubing and the casing. Such a dual-zone installation is used where:

1. It is necessary to *pump* the *lower* zone. The tubing may be anchored to the packer to prevent movement of the tubing during the pumping cycle which will allow for increased plunger travel.

2. With *both* zones flowing, the differential pressure across the packer (from below) is greater than 2000 psi.

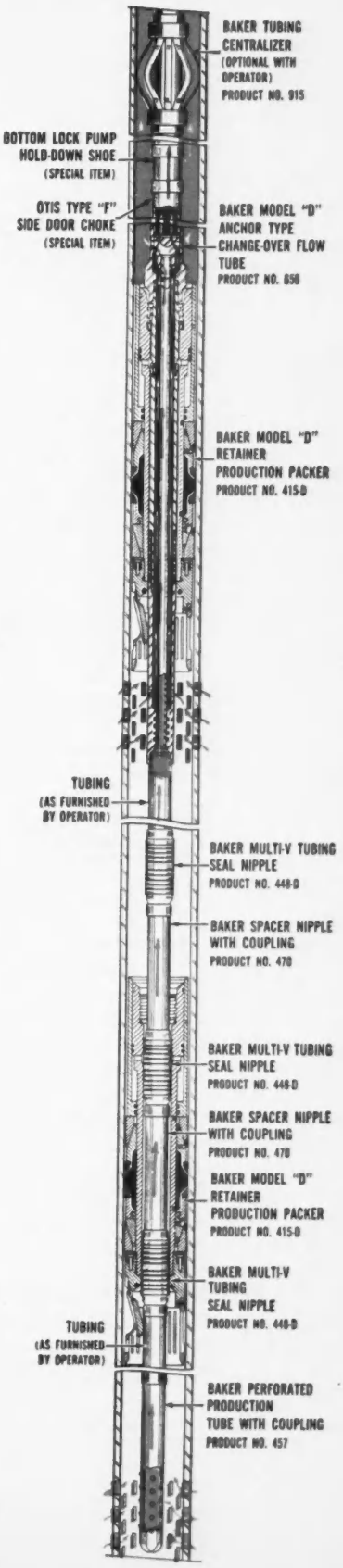
3. It is necessary to produce the *lower* zone, and inject water or gas from the surface into the *upper* zone.

4. The *upper* zone is produced through the annulus between the tubing and the casing, while water or gas is pumped down the tubing into the *lower* zone.

**RIGHT**—This dual-zone hook-up is designed primarily to permit *pumping* the *upper* zone and *flowing* the *lower* zone. Two Baker Retainer Production Packers, an Anchor-Type Change-Over Flow Tube and other Accessory Equipment are required. The *lower* packer is set *just below* the *upper* zone in order to prevent an excessive amount of sand from settling on top of the packer. The *upper* packer is set immediately above the *upper* zone, and continuous isolation of the zones is maintained.

The tubing string is held in tension for efficient pumping; the pump can be pulled for re-placement of parts, the *lower* zone meanwhile remaining isolated; provision is made for washing out sand or settlings to facilitate removal of the production string. In fact, nothing is lacking to provide flexibility of operation, combined with efficient, low-cost, permanent, dual-zone production.

*The new, 84-page Baker Packer Brochure contains many other interesting installations, and will be sent to any oil man upon request. Or see your nearest Baker representative for specific recommendations.*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BAKER MULTI-V TUBING SEAL NIPPLE PRODUCT NO. 448-D
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## SIMPLIFY PRODUCTION PROGRAMS

# PREDICTION OF CORROSION In Oil and Gas Wells

By D. A. SHOCK and J. D. SUDBURY
Continental Oil Company, Ponca City, Okla.

CORROSION in oil and gas wells, other than in sour crude areas, had received little or no attention before 1945 and 1946. The severe corrosive attack noted in high-pressure condensate wells about that time initiated considerable study of internal corrosion problems. The greater portion of this work applied specifically to gas condensate corrosion. However, in the past few years, it has become increasingly evident that there are definite correlations which can be made to oil field practice. Many of the techniques and generalizations on corrosive mechanisms made in condensate corrosion studies can be applied to oil field corrosion studies.

### The Corrosive Medium

In either oil or gas wells, the first prerequisite for corrosive action is the presence of liquid water. Corrosion takes place in the water phase and consequently a full knowledge of the nature of this phase is necessary to understand or predict the course of corrosion. A major difference between oil and gas well corrosion is the behavior of the water phase. In condensate wells, the liquid water increases from formation to surface and there is good evidence that the liquid water is swept up the surface of the pipe in intimate contact with the steel. The corrosive water produced in a condensate well nearly comes to equilibrium reacting with the steel by the time it reaches the surface. In the case of an oil well, water production is the same from the formation to the surface and the possibility of selective water flow along the pipe is improbable. Contact time with the water is reduced and surface effects, such as preferentially oil-wet areas and emulsion formation, make oil wells less corrosive than condensate wells of the same corrosive potential.

The primary cause of internal corrosion is acidity of the water phase. This is true in gas condensate and sweet oil production and, though no fundamental work has proved the point, there is good field evidence that this is true in sour crude corrosion. The mechanism by which an acid reacts with a metal describes the corrosion process in its simplest terms. Attempts to correlate corrosion and various types of galvanic action and measurements of current flow have been unsuccessful in explaining the observed phenomenon. On the other hand, the evidence accumulated in correlating corrosion and acidity has given a much more satisfactory explanation of the phenomenon.

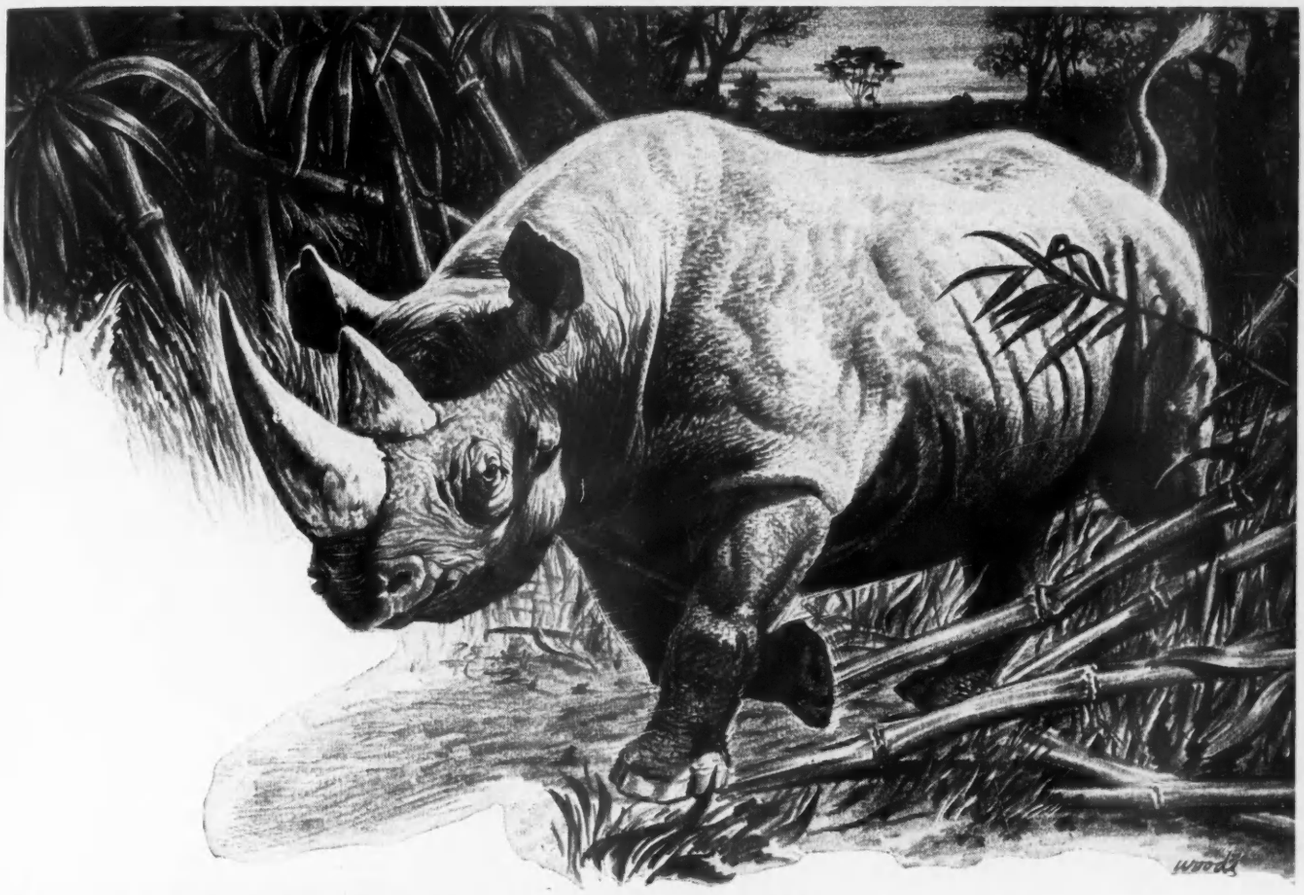
In the simplest terms, it is believed that internal corrosion of oil wells is the result of the hydrogen ion concentration in the water. The tendency to corrode is measured by the number of hydrogen ions. The rate is measured by the number contacting steel per unit of time. The hydrogen ions are supplied by the lower fatty acids, carbonic acids, and hydrogen sulfide. These are the corrosive agents. There is considerable variation on how the hydrogen ions are supplied to the solution by these corrodents, as they exist alone or in mixtures, and how the pure or mixed corrodents form corrosion products which alter the manner in which the steel is attacked. A more detailed discussion of the action of the fatty acids and carbonic acid will be made later.

**PREDICTION TECHNIQUES and evaluation methods have been extended to oil well corrosion, based on the techniques and fundamental data developed by the corrosion studies in high-pressure condensate wells. In light of the action of various corrodents and variables, the utility and limitations of the various prediction schemes are presented and a recommended plan of corrosion evaluation is set forth. This paper was presented at the Spring Meeting of the Pacific Coast District, API, at Los Angeles, May 11, 1951.**

The data on hydrogen sulfide are not yet available but are mentioned here because it is believed that correlation does exist in the sour crude systems. The problem becomes one of recognizing that the acids exist in the water, estimating their concentration, and the probable course the corrosion will take. Some information is available on the types of corrosion which can be expected for carbon dioxide and acetic acid in their mixtures and will be discussed later in detail.

Two of the corrodents, carbon dioxide and hydrogen sulfide, are gases at surface conditions. The gas phase represents a source from which corrodent can be continually supplied. The quantity of acids in the water depends on the solubility of the gases. Where sufficient or comparatively unlimited gas is available, pressures and temperatures are the chief controlling factors of the gaseous corrodent concentration in the water phase. The concentration of the gas dissolved in a liquid increases with the rise in partial pressure and decreases with increasing temperature. Thus, water coming from the reservoir to the surface, which contacts a carbon dioxide containing gas where both temperature and pressure decrease, will have an effect of increasing solubility by temperature effect and decreasing solubility by pressure effort.

The actual potential corrosiveness of the well water will depend on how these factors combine to affect the



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total dissolved carbon dioxide content. Figure 1 demonstrates the data on an oil well showing the temperature and pressure traverse and resultant carbon dioxide concentration in the water phase. The gas produced in this well contains 2.5 prcent carbon dioxide. Solubility points have been calculated for the points of pressure and temperature, using existing solubility data for carbon dioxide in salt solutions. The shape of the curve shows that, in this particular well, there is a high concentration of dissolved carbon dioxide at the bottom of the hole. It decreases in concentration at about two-thirds the distance up the tubing and increases again at the surface. The surface concentration is less than concentration at the bottom of the hole. It is interesting to note that in this well it has been proven that corrosion rates follow this carbon dioxide concentration curve.

While corrosion is due to hydrogen ion concentration, regardless of source, the path and various forms it exhibits are dependent on the anion providing the hydrogen ion and the nature of the other ions in the water. Thus, fatty acid corrosion, carbonic acid corrosion, and hydrogen sulfide attack, show widely different types. The mixtures of these three corrodents with each other and the various anions from dissolved salts and soluble organic compounds can make significant changes in the course of corrosion. No producing well contains only one corrodent. In order to determine the effects of each of the corrodents and their mixtures, their action under controlled conditions must first be investigated.

The development of methods for laboratory tests of field corrosion is still in the embryonic stage. Numerous systems have been devised but no completely satisfactory apparatus has yet been produced. The apparatus developed for this work is still in the experimental stage, but it contains features which have been essential considerations for making corrosion studies. The apparatus consists of a mechanism of rotating steel coupons at a known rate in a solution whose composition can be controlled. Oxygen is excluded by introducing oxygen-free solutions and maintaining a controlled composition atmosphere of gas bubbling through the liquid. It is constructed to withstand pressures of 15 pounds per square inch and is placed in a constant temperature bath so that temperature effects can be evaluated. Figure 2 shows the operating part of the apparatus. This unit was clamped to a heavy-walled pyrex jar to give a pressure seal and closed system.

The coupons used are standard 1 x 8 inch coupons used in the field evaluation studies. They are inserted and removed through the pressure-lock system so that no oxygen can enter the main apparatus. Piping gases and solutions in and out of the apparatus is handled by connections through the plastic top. pH measurements are made by withdrawing a portion of the liquid into a separate chamber which is closed from the atmosphere but electrically isolated from the main bath. The fatty acid concentrations are maintained by introducing acetic acid into the water phase. The carbon dioxide concentration is maintained by controlling the partial pressure of carbon dioxide in the gas bubbling through the apparatus.

In studies of partial pressures less than one atmosphere, natural gas and carbon dioxide are proportioned by rotameters in relative volumes to give the required partial pressure. In partial pressures above one atmosphere, only carbon dioxide is used so that the total pressure on the apparatus will equal the partial pressure. Thus, partial pressures of two atmospheres can be obtained.

The effect of added salts can be studied by adding them in the water phase as is done with the acetic acid. Time-rate curves can be plotted by withdrawing and weighing coupons at various lengths of exposure. The surfaces are examined microscopically for pit attack and corrosion products can be identified by various analytical techniques. Corrosion by acetic acid, carbonic acid, and mixtures have been studied thus far in this apparatus; it seems to be a basically sound design. The curves to be discussed were developed using this apparatus.

### Fatty Acid Corrosion (Acetic)

The laboratory studies on the corrosive effects of water-soluble fatty acids are generally done using acetic acid. The justification for this has been that Lochte[1] and co-workers have found that the greatest proportion of these acids in the water phase was acetic acid. The hydrogen ion activity of all the fatty acids is not too variant from that of acetic acid. Menaul[2] and Griffin and Greco[3] describe the corrosion in condensate systems caused by the fatty acids and, for a time, they were believed to be the principal causative agents in corrosive condensate wells. The laboratory and field studies demonstrate otherwise and their presence is now believed to be a contributing rather than a principal source of corrosion.

A series of experiments following the pH decline with time exposure[4] under controlled anaerobic conditions demonstrated that acetic acid will react with steel, forming ferrous acetate at a rate controlled by the temperatures of the solution and the velocity or volume of solution moved past the surface. The increase in temperature increased corrosion rates in amounts expected from chemical reaction rates. These results were taken as an indication that acetic acid corrodes steel by the solution of the metal or the surface products to form soluble ferrous acetate. Temperature affects the rate at which this reaction takes place in the same manner as it would any chemical reaction. Corrosion-rate

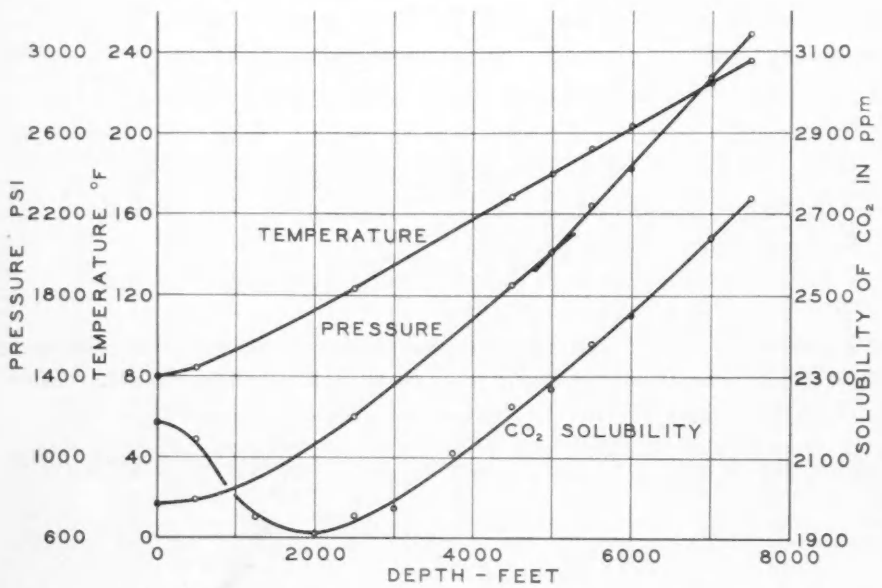


**FIGURE 1. Subsurface $CO_2$ solubility calculated from pressure and temperature surveys of a corrosive oil well.**

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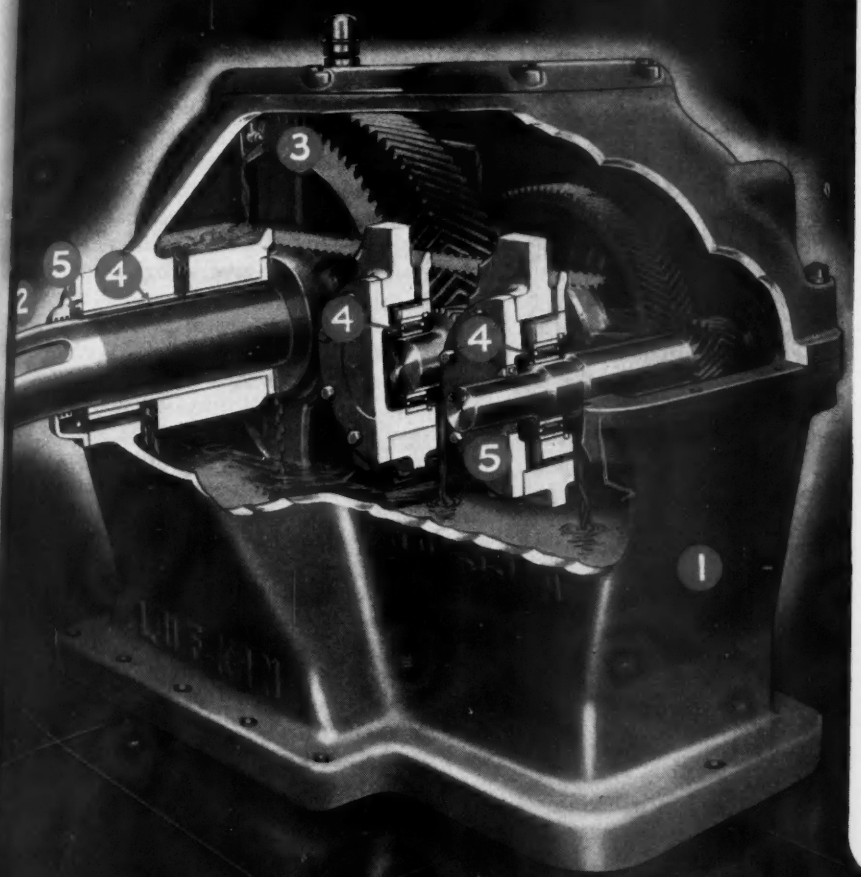


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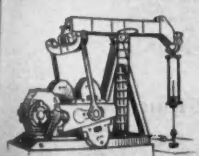

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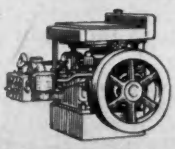

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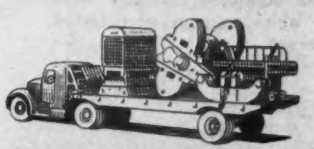

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curves exposing a series of coupons have shown that insoluble corrosion products are built up which generally reduce the rate. The composition of this corrosion product has not yet been determined.

Hackerman and Glenn[5] reported rate curves which followed no general pattern with concentration, using an apparatus which sprayed the coupons with acetic acid solution in anaerobic atmospheres approximating condensate well service. Corrosion rates, using the apparatus described above, have been determined and are shown in Figure 3. These curves show that the rate decreases in time, which is indicative of a semi-protective film being established. The corrosion rate does not drop to a negligible amount, however, and the metal continues to lose weight.

It is important to note that in no case in any of the coupons was a pit attack found. Temperature is found to change the slopes of the curves but not their general shape. Concentration has no effect on the shape of the curves in this appartus as it did in the results of Hackerman and Glenn. Both results, however, showed no pit attack and a decrease in rate with time when a semi-protective film was established.

### Carbon Dioxide Corrosion

The fact that the carbonic acid concentration is pressure and temperature dependent makes corrosion tests more difficult to interpret on a comparative pH basis with the acetic acid. The forms of the curves and progress of corrosion, however, can be shown by the usual rate-change curves. These show some very significant differences from the acetic acid curves. The carbonic acid available for corrosive action is not only that which exists in solution like the acetic acid but is the amount which will dissolve from the gas phase after the reaction of the part already dissolved has taken place.

The laboratory apparatus approximates the action in the wells in that carbon dioxide is continually fed to the system to maintain its saturation equilibrium at the test temperature and partial pressure. Tests with the present apparatus do not cover a wide range of conditions but they do demonstrate the mechanism. In Figure 3 a corrosion curve is shown for coupons exposed to one atmosphere at 130° F. This curve represents the corrosion pattern of a joint in the tubing near the bottom of the well. The shape of the curve shows that the corrosion rate continues at a fairly constant value. There is no formation of a semi-protective layer. The layers formed aid pit attack so that after a time pits can be seen on the coupons which deepen as the corrosion progresses.

From previous work in other apparatus, it was found that the solutions saturated with ferrous bicarbonate at one atmosphere pressure, which would be the equivalent to the joints at the top of the tubing, show the same type of curves and pit attack, although the rate (slope of the weight-loss curve) was less than for the unsaturated iron solutions.

A comparison of the carbon dioxide weight-loss curve and acetic acid curve illustrates the reason why carbon dioxide corrosion is considered a major corrosive agent in the field. The fact that the corrodent is continuously supplied, that the reaction is not self-stifling, and that pit attack is produced, support this claim. The carbonic acid concentration where negligible corrosion takes place has not been determined. It has been demonstrated by numerous experiments that a partial pressure of one atmosphere carbon dioxide or greater will give carbonic acid corrosion in most produced waters and that a partial pressure of .5 atmosphere carbon dioxide is in the neighborhood of a less severely corrosive range. This value is used as a rough estimate of the acid content where severe corrosion may be anticipated.

In actual practice, few wells have only one corrodent, so the study of mixtures becomes a most important part of the problem. The determination of conditions under which a well will corrode in accordance with the pure fatty acid or the pure carbon dioxide curve is an important consideration in predicting the type of corrosion to be expected. Sufficient data are not yet available to define clearly the conditions for controlling mechanisms. It is evident that the presence of acetic acid decreases the lower limit of the carbon dioxide effect so that a lower partial pressure of carbon dioxide will still give a high continuing rate and pit attack.

The effect of mixtures of .5 atmosphere carbon dioxide and 500 parts per million acetic acid is also shown in Figure 3. The addition of fatty acids to a system containing sufficient carbon dioxide to be corrosive increases the rate and severity of this attack. Data from the field on wells which contain low partial pressures of carbon dioxide (.1 atmosphere or less) and have organic acids in the water have been shown to develop typical acetic acid corrosion rate curves. The salt effects, which will be discussed later, may have a large enough effect in these wells to make the determination of such a limit of little utility in actual predictions.

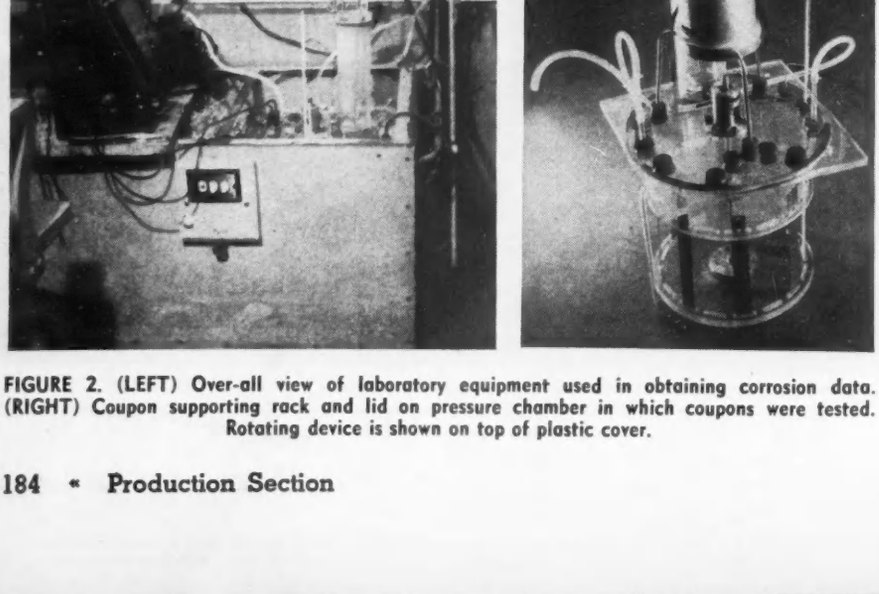

**FIGURE 2. (LEFT) Over-all view of laboratory equipment used in obtaining corrosion data. (RIGHT) Coupon supporting rack and lid on pressure chamber in which coupons were tested. Rotating device is shown on top of plastic cover.**

### Retardants

While the acids present in the water phase act as the aggressive agents, there exist compounds in the well systems which may retard the corrosion rate to such an extent that the well is considered non-corrosive. Such an occurrence is not uncommon and the fact that these situations do exist has caused some difficulty in identifying and evaluating the causative corrosive agents. The retarding agents fall into two general groups, the organic polar molecules and inorganic or buffering salts.

Some of the early rate curves run

in condensate wells showed that, with essentially the same potentially corrosive atmosphere, no corrosion took place.[6,7] After considerable study this difference was attributed to the presence of polar compounds in the fluids of the non-corrosive well. These compounds were not found in the fluids of the corrosive well. Rogers[8] demonstrated that addition of polar organic compounds such as turkey red oil and naphthenic acids to the well fluids changed the wettability of the steel and reduced the corrosiveness of a given system. He later demonstrated[9] that in oil wells certain crudes displace water from the steel surface and the addition of small amounts of organic compounds formed a completely oil-wet surface, thereby reducing corrosion rates in the well.

Lochte[10] has found the presence of numerous oxygenated, high-molecular weight compounds in the condensed hydrocarbon phase of condensate wells. Their presence is also known in crudes, particularly those from California, West Texas, Wyoming and Kansas. There is little published information on the effect of various additives in the oils in a laboratory test apparatus such as has been used and discussed in this paper. These compounds, however, are similar in action to the organic inhibitors used in corrosion mitigation and are often termed "natural inhibitors." The subject of "natural inhibition" has not been investigated in any systematic manner and needs further proof in order to establish how widespread this effect may be. Regardless of the exact chemical compounds, the effect has been noted in the field in any number of cases and is easily detected by the coupon method.

Another group of compounds which can be classed as retardants is the dissolved salts which limit the hydrogen ion concentration. The produced waters containing these salts are then less acid than the partial pressure of carbon dioxide and temperature would indicate; thereby, the corrosion rate may be appreciably diminished. This buffer salt effect usually is not great enough entirely to eliminate the corrosion but may alter its severity and course. No data are available on the effects of natural-occurring buffer salts on the rate-change curve. However, this buffering action is the basis for the use of neutralizing agents such as sodium carbonate, bicarbonate, magnesium metal, and its salts as mitigation methods.[11,12]

### Prediction Methods

Having assembled the factors which influence internal corrosion, we now must be able to apply them to a particular well system if they are to be useful in our prediction work. In common with all prediction methods, the better the data and the better the evaluation of all influencing factors, the more likely the prediction will be fulfilled by performance. A weighed decision, balancing the worth of the increased accuracy of prediction against the cost of obtaining it, always confronts the corrosion engineer. Consequently, numerous evaluation schemes are used which yield varying approximations of true performance. These various short methods must be judged in the light of basic theory and principles if they are to be useful; otherwise, the interpretations of corrosive behavior are confusing and misguiding.

Direct observation of a corroded piece of metal is more fact than prediction; however, such corrosion cases are usually warnings of the possibly more serious corrosion and such cases should serve as an order to investigate the potential corrosiveness of a well. In like manner, caliper surveys serve as a check on the severity of corrosion in tubing and casing; periodic checks indicate the rate and course the corrosion is taking. The discussion of corrosion logs supplied by the company includes the evidence of pit corrosion and general corrosion and, if the corrosion is localized at one depth or extends through the entire system, the caliper survey also serves as a check on other prediction methods rather than operating as a primary method itself. The caliper survey, combined with other prediction methods, is very useful.

Since we explain the corrosion mechanism as an acid attack and the field data give evidence that this mechanism is correct, we are able to predict potential corrosiveness by measuring or estimating the pH in the water phase under well conditions. This can be done by analytical means and knowledge of the physical conditions. Eilerts[12] gives pH relationships for concentrations of carbon dioxide and the fatty acids in the concentrations as they occur in wells. Other values have been reported to the NGAA Corrosion Projects Committee and are in the process of being released for general publication.[13]

The usual procedure is to determine the carbon dioxide content of the gas at atmospheric pressure. From the total pressure, the partial pressure of carbon dioxide is determined. Then the effect of temperature at that partial pressure is estimated and the approximate pH value is determined.

The fatty acid content is run on a sample of the water by titrimetric procedures outlined in the NGAA Corrosion Projects Committee's Tentative Standard Methods. The acidity developed from this source is estimated on the basis of the estimated acetic or propionic acid concentration found by analysis. Corrosion has been found to take place at pH values of 5.5 or less. The probable course of corrosion expected will depend on the anions present and was outlined briefly in the first part of the paper.

After a year of intensive field study and correlation work sponsored by the NGAA Corrosion Research Pro-

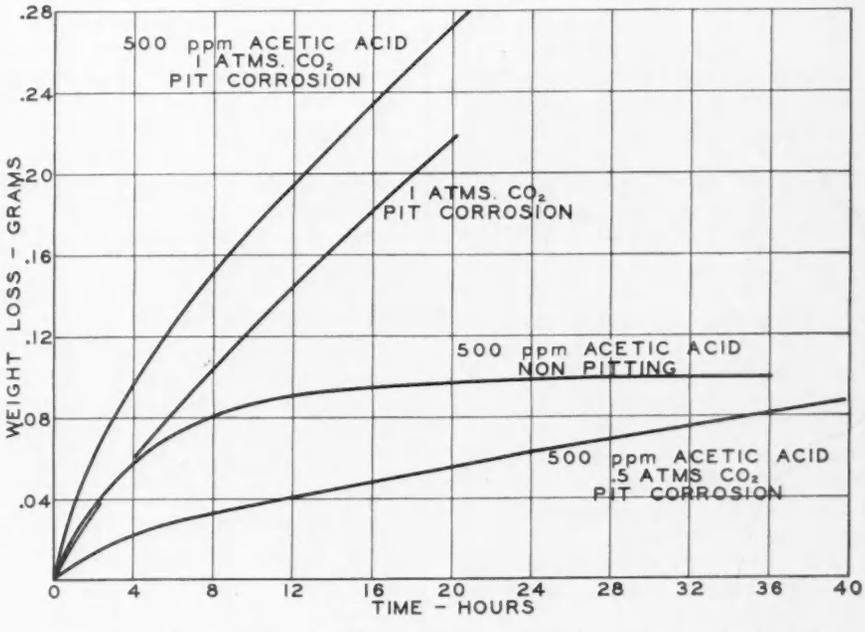


**FIGURE 3. Typical corrosion curves for $CO_2$—fatty acid and $CO_2$ and fatty acid solutions.**

jects Committee, it was concluded that the following general rules were applicable to condensate well corrosion:[14]

- Severe pit-type corrosion is to be anticipated in wells producing water contacted by a gas containing carbon dioxide at a partial pressure of one atmosphere or greater (well water pH 4.0-4.5).
- Moderate or general corrosion is to be anticipated in wells in which the water contains the lower fatty acids and in which the gas phase has a low partial pressure of carbon dioxide (.2 atmosphere or less).
- No corrosion is to be anticipated in wells containing no fatty acid in the water and the carbon dioxide partial pressure is less than .2 atmosphere.
- The lower fatty acids increase the severity of the corrosion described in Case No. 1 so that a combined carbonic acid and fatty acid corrosion gives rise to a very severe pit attack.

These rules, first proposed in 1947, have been shown to be good first approximations in corrosion predictions and as such continue to be useful. The intermediate corrosion ranges and determinations of conditions for the differences in type attacks are not well defined nor is the limit of the corrosive acid range well determined. The approximations just made, if generally applied and used, would greatly improve the anticipation of corrosion.

Systems have been devised for measuring pH values under wellhead conditions[15, 16] which obtain estimates of the effect of dissolved salts and give proofs of the actual acidity in the produced water under well conditions. The data developed by these methods were useful in adding proof to the theory but are usually too lengthy to be used as prediction methods. The system used by Carlson[16] of placing the produced water sample under a pressure of carbon dioxide, which is equal to the partial pressure in the well, is useful in estimating actual pH values. His method gives an evaluation of the possible buffer behavior of the dissolved salts and shows good correlation with observed corrosion in the field and pH at field wellhead conditions.

Predictions based on the amount of metal lost per-unit-time are standard corrosion procedures. Both the indirect method, using iron contents of the water, and the direct method, using coupon exposures, are widely used and misused. Both methods are valuable tools but the results can be easily misinterpreted.

The use of the iron content in produced waters for corrosion criteria assumes that the iron in solution comes from the corrosion of the steel. Useful as this method may be, it is the one method most subject to variation and can be applied only in a limited manner. In corrosive condensate wells, most of the water comes from the condensed vapor. The total amount is small and good contact is maintained. The water produced by them will have high iron values in terms of concentration. Thus, 100 to 200 parts per million iron is common in such cases.

In corrosive oil wells where the total water volumes are much greater, the iron contents may be much lower, so that 25 ppm iron content in a water may be indicative of a corrosive well. Trying to apply a general rule to both oil and gas wells and taking into account the total water produced, a system of evaluating corrosion by calculating iron as total pounds of iron lost per day has been suggested. This eliminates some of the discrepancy between high and low water producers. However, the corrosive limit values are not the same for both condensate and oil wells.

Very little data have been accumulated to ascertain if this method will be useful for prediction. One of the difficulties with any iron content method lies in the fact that the iron may come from the formation and not from corrosion. Results of a recent test clearly demonstrated that 130 ppm iron, or equivalent 90 pounds per day removal indicated loss, was coming from the formation. Practically no corrosion was taking place in the well.

The principal use of iron determinations in water, therefore, is a first check of possible corrosion. When the severity of the corrosion is established by other methods, the iron values are useful in following mitigation treatments. The method fails to give an indication of the type of corrosion. If insoluble iron products are formed, the method becomes unreliable or of no use. For instance, in hydrogen sulfide systems, the soluble iron reprecipitates as iron sulfide. No iron is found in solution even in quite corrosive waters. If the iron is from the formation, the corrosion estimates are in error.

### Coupon Methods

As with iron values, the coupon method is one of the most commonly used corrosion evaluation methods. The most common method in oil field practice is to insert a tarred steel coupon, usually 1020 steel, into the flow line for a known period, usually two weeks, and weigh again after descaling. The weight loss calculated to an average penetration value and reported as thousandths of an inch penetration per year (mpy) is indicative

## About the Authors

Sudbury

Shock

J. D. SUDBURY, senior research chemist in Continental Oil Company's production research laboratory at Ponca City, received his B.S. degree in chemistry from the University of Texas in June, 1944. He served in the U. S. Navy during the following two years as an electronics technician. After discharge, he re-entered the graduate school of the University of Texas and was appointed to a Navy research fellowship in the corrosion research laboratory. After receiving his M.A. and Ph.D. degrees in physical chemistry, he joined Continental in August, 1949. He is a member of Phi Lambda Upsilon, Sigma Xi, and the American Chemical Society.

D. A. SHOCK, senior research chemist in the production research laboratory of Continental Oil Company at Ponca City, Okla., previously served on the research staff of the University of Texas at Austin, in charge of corrosion research problems. He is the author of several papers on corrosion and allied chemistry problems, and has done considerable work on condensate corrosion. Prior to his work at the University of Texas, he was with International Minerals and Chemical Corporation, Austin, and Dow Chemical Company, Midland, Mich. He is a member of the National Association of Corrosion Engineers, and the American Chemical Society. Shock is a chemical engineering graduate from Colorado College, and obtained his master's degree in chemistry from Texas University.

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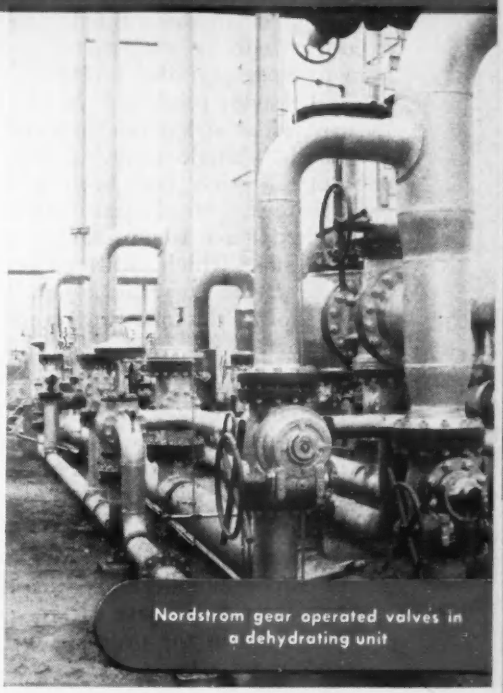

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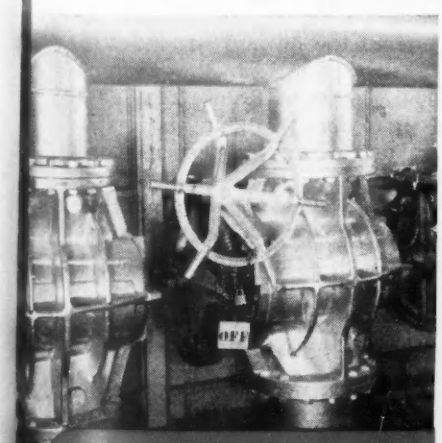

Nordstrom 16" Multiport valves in gas compressor room

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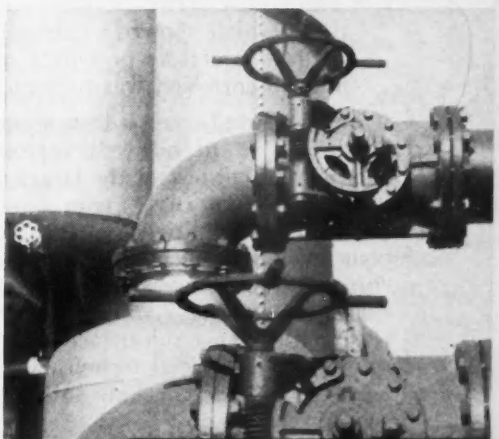

Nordstrom valves in a manufactured gas plant

of the corrosion taking place. The surface of the coupon is examined microscopically for evidence of pit attack or evidence of protective surface film formation.

Work on coupon testing in condensate wells proved that the results obtained are indicative of the rates found in the well. Experiments performed at the University of Texas[6, 7, 17] determined rate curves by exposing multiple coupon sets in numbers of condensate wells. These rate curves gave results of typical curves obtained in the laboratory exposure tests and were discussed in a previous section. It was shown that very corrosive wells gave weight-loss curves like the typical carbon dioxide and carbon dioxide-acetic acid curves. The moderately corrosive wells gave curves like the typical acetic acid exposures and the non-corrosive wells showed a very low penetration rate and evidence of a protective film on the surface of the coupons.

This type of coupon testing undoubtedly gives the best basis of estimated performance. However, it is too expensive for anything but exceptionally difficult cases. Single-coupon exposures can be compared with known types and the probable corrosion behavior predicted. In the extensive tests carried out in condensate wells[14], single wellhead coupon exposures, which had been left in the well until a steady state had been established, gave some average penetration rates which indicated severe and less severe corrosive types. This survey showed the following results:

- The very corrosive wells, which were the ones containing high partial pressures of carbon dioxide, gave surface coupon rates in the order of 10 mpy or more, along with evidence of pit attack.
- The moderately corrosive wells, those with low partial pressures of carbon dioxide, and which contain fatty acids, gave surface coupon rates in the order of 5 mpy and no pit attacks.
- The non-corrosive wells were those which showed evidence of natural inhibitors or buffer salts and no corrosion was present.

These general coupon tests seem to be applicable to oil well corrosion except that, because of the larger differences in pressure from top to bottom-hole conditions, surface coupons give low results. Thus, a severely corrosive well showed surface coupon corrosion rates of 7 mpy or less but was found to have subsurface rates up to 80 mpy. A special technique[18] has been devised for checking subsurface corrosion rates and has proved very useful in such cases.

## Conclusion

The complexities of corrosion behavior are so great that it is difficult, if not impossible, to outline a single simple method for evaluating and predicting corrosion in all wells. The corrosion engineer must understand the possible corrosive mechanisms, then choose the methods which give adequate information at an economical cost. The acidity rules help in anticipating corrosion, the coupon systems help define its course, and the iron content methods are useful as indicators or comparison controls for mitigation methods. All these methods are useful, but the data yielded must be judged in light of the conditions of the particular well under test.

It is evident that the prediction methods are still in a state of development. Considerably more fundamental data must be accumulated before our present approximations can become more exact. It is believed that an extension of the laboratory studies such as were described in this paper could greatly extend our prediction accuracy and add to the usefulness of our present methods.

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## Tests for Gas Wells

• CONTINUED FROM PAGE 177

field it can be conservatively estimated that on the 3255 wells appearing on the official proration schedules for July, 1950, in Kansas, Oklahoma, and Texas, the gas which would be wasted for the annual 20-minute pitot tube test would be approximately 1 billion cubic feet. Test records for the West Panhandle field of Texas reveal that the average volume of gas wasted to air in a back-pressure test is approximately 4 million cubic feet per well. This would result in a gas waste for an official annual test, if such tests were still in effect in both Hugoton and Panhandle fields, of approximately 8½ billion cubic feet. If it can be assumed that this gas is worth 10 cents per Mcf at the well head, the value of gas which would have been wasted on the old type test would be approximately $850,000.

Major credit goes to the state regulatory bodies in the program which has been set up for obtaining more accurate and dependable test data and the resulting decrease in gas waste by the adoption of the deliverability type of gas well testing in many of the major gas fields of the U. S.

## About the Author

C. H. HINTON is chief production engineer and superintendent of production and gathering properties for Panhandle Eastern Pipe Line Company. He completed his work at the University of Illinois in mechanical engineering in 1928. After a short time spent on sound control work, he entered the oil and gas industry as an engineer in the Monroe field, Louisiana. Since that date he has done work in the major producing states and some work in Canada. He is a registered professional engineer, a member of the American Gas Association Reserve Committee, a member of The American Petroleum Institute, and of the American Institute of Mining and Metallurgical Engineers.

**CONSIDERABLE THEORY** on the two primary types of oil field emulsions and their effect on oil production are presented. Four emulsion stabilizing agents are described as to the role they play in emulsions. Extensive laboratory tests indicate that these emulsions can be dispersed through the use of an organic (aromatic) sulfonic acid. The use of this chemical compound in stimulating oil production is shown to be effective in many cases. Blocking of oil producing by water, either by conate or invade water, can be alleviated by treatment with this acid as laboratory tests conclusively show.

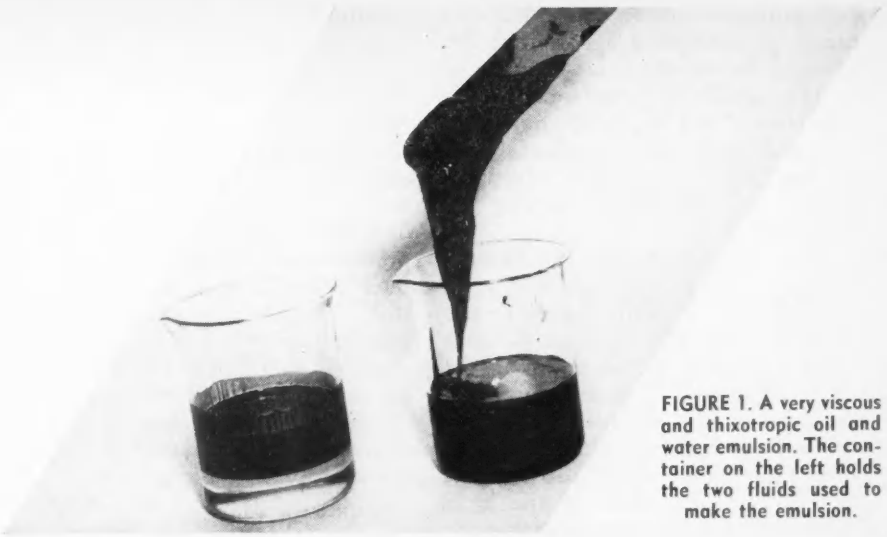


FIGURE 1. A very viscous and thixotropic oil and water emulsion. The container on the left holds the two fluids used to make the emulsion.

# Removal of Water and Emulsion Blocks To Stimulate Oil Production

By WAYNE F. HOWER
Halliburton Oil Well Cementing Company, Duncan, Okla.

*Part 1*

THE ever increasing demand on the oil industry to produce more oil and the developing shortage of essential materials for new wells is placing further emphasis on the need of increased production from existing wells and new wells being completed. A major obstacle to production is water in the oil bearing formation. This water is frequently foreign to the formation and may come from a variety of sources such as water loss from drilling mud or water from a casing leak. Formation and/or connate waters are usually present in most formations. This water can cause a partial or complete water block to the flow of oil to the well bore and connate water will always cause the effective permeability of the sand to oil to be reduced. Theory holds that continued oil production will cause a gradual movement of the connate water to reduce further this effective permeability.

### Permeability Blocks

Many crude oils and various waters are capable of forming emulsions. These emulsions are almost always more viscous than the crude oil and form an even more effective block to the flow of oil than water alone. Emulsions, in addition to their high viscosity, often exhibit thixotropic properties. This property prevents obtaining accurate viscosities of the emulsions and making calculations of their flow characteristics. Only apparent viscosities can be obtained and then the values shown are dependent on the rate of shear of the instrument employed in making the measurements.

Such a thixotropic emulsion is shown in Figure 1. The container on the left holds the crude oil and water used to make the very viscous and thixotropic emulsion shown on the right. These thixotropic emulsions may be so thick that they resemble an elastic solid. When such an emulsion is stirred or caused to flow, the thixotropic structure is partially destroyed but will slowly heal on standing. There are probably loose linkages between the colloidal particles in the emulsion which are progressively broken down by increasing rates of shear, thus accounting for the various values of apparent viscosity that are obtained.

A variable speed rotating type viscosimeter (Brookfield) illustrates this phenomenon. The following values were obtained for the same spindle at the noted speeds of rotation.

| Speed of Rotation | Apparent Viscosity |
|---|---|
| 6 RPM | 12,400 Centipoises |
| 12 RPM | 7,800 Centipoises |
| 30 RPM | 3,950 Centipoises |

A different viscosimeter rotating at 600 revolutions per minute showed an apparent viscosity of 295 centipoises on the same emulsion. The healing time was very fast as the emulsion would not flow from the container three minutes after agitation was stopped. Such an emulsion would form a very efficient block to the flow of oil in a producing formation.

### Emulsion Theory

Many theories have been developed on emulsions and their formation. When two liquids which are insoluble in each other are put together and shaken violently, one of the liquids is dispersed in the other but, when agitation is stopped, the particles coalesce and the two liquids separate to form two distinct layers. If a third substance is introduced which lowers the interfacial tension of the two liquids, it is possible to form an emulsion of the two liquids which appears to be stable. The emulsion consists of droplets of one liquid suspended in the other producing a continuous and

a discontinuous phase. The third substance, or stabilizing agent, that lies between the boundary or interface of the two liquids, governs some of the properties of the emulsion, but more is needed than a low interfacial tension or the inevitable electrical charges to completely stabilize all emulsions.

It has been shown that the stabilizing agent can be a tough, coherent, or plastic film. Bancroft has made the empirical generalization that the continuous medium is that in which the stabilizing agent is more soluble. In conjunction, the oriented molecular wedge hypotheses should be considered. This theory takes into account the relative dimensions of the head and tail of a soap molecule where one end is soluble in one liquid and the other end soluble in the other liquid. The two phases are supposedly held together by a number of these molecules orientated through the interface of the two liquids.

There are two types of emulsions which are commonly classified as water-in-oil and oil-in-water emulsions. A simple test to determine the type of emulsion is to place a drop of the emulsion in a container of water and in a container of oil. If the drop spreads in the oil, the external or continuous phase is oil and there is a water-in-oil emulsion. If the drop spreads on the water, the external or continuous phase is water and we have an oil-in-water emulsion. There are exceptions where this test fails to show clearly the type of emulsion. Microscopic examination of the emulsion diluted with either phase will usually classify the type. Here is evidence that a mixture of the two types of emulsions are present and that the predominant type is being determined. Such a condition is undoubtedly unstable and the mixture will gradually change to almost entirely one type of emulsion. Another variation is the formation of multiple emulsions. There is a known example of an oil-in-water-in-oil-in-water-in-oil quin-qui-multiple emulsion.

### Stabilizing Agents

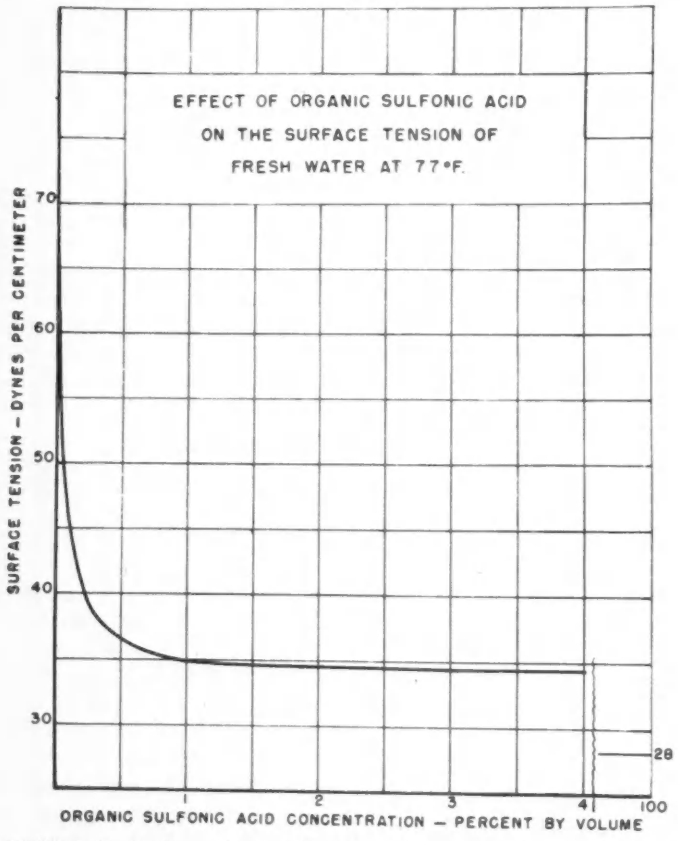
There are four types of stabilizing agents. Probably the most common are colloids and films of colloids of which common soaps and synthetic wetting agents are examples. Others can form a tough and tenacious film which is the most effective method of stabilizing an emulsion. Polar substances are another type in which part of the molecule has an affinity for water and another part for oil.

A third type covers the field of finely divided solids. Basic salts, bentonite, calcium carbonate and pyrites stabilize oil-in-water emulsions while carbon black is a water-in-oil stabilizer. The general rule is that the liquid which wets the solid better, so that the interface meets the solid at an acute angle in that liquid, is the other phase. If the contact angle is 0, 90, or 180 degrees, no stabilization can occur because the solid will go into one or the other liquid entirely or exhibit no preference. The intermediate angles exhibit the maxima for the formation of emulsions.

The fourth type consists of mixed stabilizing agents. Incompatibility may exist where the stabilizers neutralize their independent effects, or a strong reinforcement may occur. A mixture of an oil-soluble substance with a water-soluble substance can produce a very stable emulsion.

The type of stabilizing agent, its concentration, the type of agitation, the degree of agitation, and the character of the fluids being emulsified largely govern the condition of the emulsion. Quite often the viscosity of an emulsion will increase with the time of agitation. In a straightforward emulsion, the type formed by a certain stabilizing agent will be the same regardless of the relative concentration of the two liquids. There has been obtained a water-in-oil emulsion of crude oil and water with the oil concentration as low as 10 percent.

There have been a few cases where not all of the water is taken up by the oil when equal volumes of the two



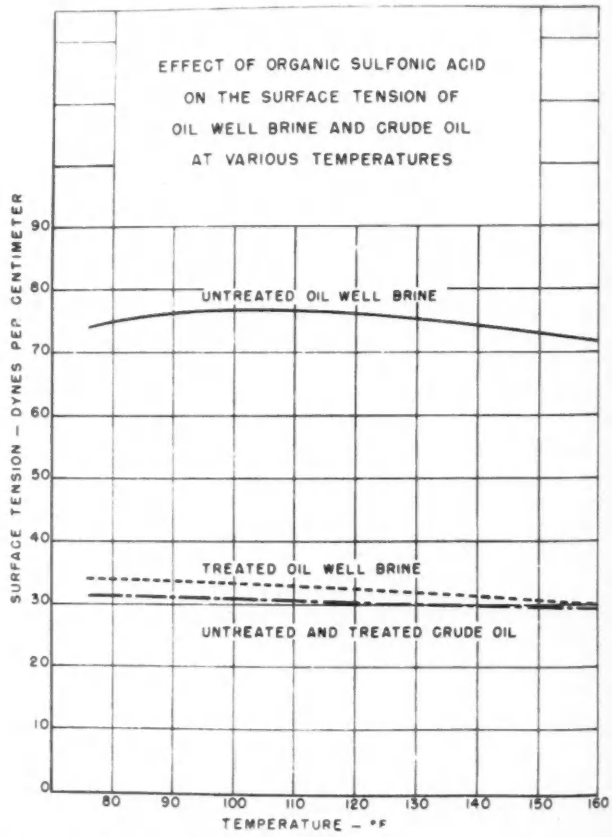




**FIGURE 2 (Left). Curve showing the effect of the organic (aromatic) sulfonic acid on the surface tension of fresh water.**

**FIGURE 3 (Right). Curves showing the effect of the organic (aromatic) sulfonic acid on the surface tension of an oil well brine and crude oil between the temperatures of 75° and 160° F.**

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fluids have been mixed, and an oil to water ratio of 2 to 1 was necessary to emulsify all of the water.

The phase of the emulsion can be reversed under certain circumstances. Metal salts of the various long chain organic acids (commonly called soaps) have varying solubilities in oil and water. A change in solubility in either liquid caused by a change in temperature can cause a phase reversal. This is in accordance with Bancroft's rule which is, to restate, "the phase in which the stabilizing agent is more soluble will be the continuous phase." The ability of some soaps to hydrolyze and thus change their solubility characteristics can also bring about a phase reversal. Sutheim[1] suggests that the continuous phase becomes entrapped during coalescence and thus causes a new and different type of emulsion. It has been noticed that there is a sudden change in viscosity as the type of emulsion changes from oil-in-water to water-in-oil or vice versa. The maximum viscosity was usually noted during this reversal of phase and is probably due to the complex or multiple type of emulsion noted above.

Mechanical agitation is not always necessary to form emulsions. Quincke[2] pointed out that the lowering of the interfacial tension by a stabilizer is sometimes localized and causes such a violent spreading that the resulting turbulance entraps globules of one of the liquids. This spontaneous emulsification can also take place by the diffusion of one liquid into the other in the presence of a stabilizing agent. In general, there are many variables and complex circumstances which make it difficult to verify absolutely the reasons for the final condition of the emulsion.

### Oil Field Emulsions

A study of oil field emulsions certainly indicates a realm of complex circumstances. There is definitely a reason why some oils form emulsions and others do not. Working along the salting out theory which holds that it is possible to form metal salts of organic acids through the reaction of the acid with the metal ion, a series of tests was conducted using a crude from Brookhaven, Miss., and water solutions containing different concentrations of metal salts.

TEST 1. Emulsified with brine from the same field to give a very thick and stable emulsion which is shown in Figure 1. This brine contained 20.4 percent solids.

TEST 2. Emulsified with fresh water to give an emulsion comparable to that obtained in Test 1. This fresh water contained 0.033 percent solids.

TEST 3. Emulsified with distilled water. An homogeneous mixture was obtained that was very thin. This mixture was not stable and quickly separated. The acid number of the Brookhaven crude oil is 1.5 which proves the presence of acids. Evidently, these acids are wholly oil soluble and are not emulsion stabilizers until the salts in the water have formed the metal salts of the acids and thus the emulsion stabilizers.

TEST 4. These tests were repeated with another crude oil (acid number 0.95) and similar results were obtained. The emulsions formed were not quite so thick as before although they too, were water-in-oil emulsions.

TEST 5. A crude oil of acid number 0.55 did not form a stable emulsion with any of the waters.

The acid numbers of all three crude oils indicate a very small percentage of organic acids in the oils. The acids are undoubtedly different in character, and this property, plus the low acid number of the crude oil used in Test 5, accounts for the difference in the results obtained. A pertinent point is that there are more than enough metal ions in the fresh water to form the metal salt of the organic acids and thus form the emulsion stabilizer.

This brings us back to the condition where it is necessary to use a 2 to 1 oil-water ratio to include all of the water in the emulsion. An explanation may lie in the complexity of the organic acids in the oil. Obviously, the chain length or molecular size of the acids would be a factor. Under certain circumstances, the complete stability of the emulsion will depend on the concentration of the stabilizing agent. This would be the case where the total interface exactly accommodates a rather insoluble stabilizing agent and, since the oil is the source of this agent, its concentration had to be increased to meet these conditions.

In the oil producing formation, we can make use of the above discussion to explain the presence of emulsions. Under pressure, a jetting action which results as the water passes through the pores in the formation can cause the necessary turbulence to form an emulsion. In addition, conditions may be right for the formation of spontaneous emulsions. Available in the formation is a tremendous amount of surface area which will encourage this phenomenon. Frequently present, especially in newly completed wells, are bentonite and other finely divided solid particles that stabilize emulsions. Therefore, there is the possibility of having emulsions stabilized by the soap type, the solid type or various mixtures of both types of stabilizers.

### Breaking Emulsions

Breaking emulsions is a complex problem. They may be broken by suitable mechanical treatment, by heat, or by freezing. Chemical additives may destroy the stabilizing agent or a stabilizing agent of the opposite type may be added. The electrical charges on the droplet have been utilized in the separation of emulsions by electrolysis or by treating with high tension electricity as in the Cottrell process. The mention of heat brings up the fact that many water and oil emulsions are broken merely by heating the emulsion. The emulsions in oil producing formations are subject to the heat of the formation, but the action of pressure tends to stabilize the emulsions and thus counteract the breaking tendency caused by the elevated temperature.

Previous attempts have brought forth a variety of methods of breaking both emulsion and water blocks

## About the Author

WAYNE F. HOWER has been an organic chemist for Halliburton Oil Well Cementing Company at the Duncan, Okla., Research Laboratory since 1946. A native of Warren, Ohio, Hower received a B.A. degree in chemistry from Youngstown College in 1937, worked for Koppers Company for 18 months, and in 1939 was awarded his M.A. degree from Indiana University. From 1939 to 1943, he was employed by Sherwin-Williams Paint Company as an organic chemist in research and development. In 1943, he joined the U.S. Navy and saw active duty as an electronics officer aboard a submarine in the Pacific Theater.

in oil producing formations, but none of these have been entirely satisfactory.

Any chemical used to treat emulsion and/or water blocked formations should have, in addition to its emulsion breaking properties, the ability to lower the surface tension of the water treated. Merely breaking the emulsion is not enough. The water will still be in the formation and must be removed before improved oil production can be obtained. Further, the emulsions stabilized with bentonite are broken primarily by the following action: surface tension of the water in the emulsion is lowered, causing this fluid to change its angle of wetting of the bentonite. The angle so changed causes the bentonite particles to go wholly into the water and thus permits the oil and water to separate.

### Aromatic Sulfonic Acid

An especially compounded chemical classed as an aromatic sulfonic acid, known as "Morflo," has been extensively studied for this application. It is insoluble in oil, soluble in water, has broken all emulsions tested and lowers the surface tension of water as shown in Figure 2. Figure 3 shows the effect of this chemical on the surface tension of an oil well brine and a crude oil at various temperatures. Surface tension measurements were made on the brine and oil between 75° and 160° F. and are shown on the graph as untreated oil well brine and untreated crude oil. An emulsion of the two liquids was prepared and broken by treatment with the organic sulfonic acid. Surface tension measurements were again made for each liquid over the same temperature range. Since the chemical is insoluble in oil, surface tension of the crude oil was not changed and we have the same curve for the crude oil before and after treatment. Surface tension of the treated oil well brine was greatly reduced over the entire temperature range and very closely approaches the surface tension of the crude oil.

It is interesting to observe the action of the aromatic sulfonic acid on emulsions under a microscope. The placement of a drop of the chemical adjacent to the emulsion initiates a turbulent action in the liquids as the emulsion is broken. This energy release may represent a part of the energy that was necessary to form the emulsion.


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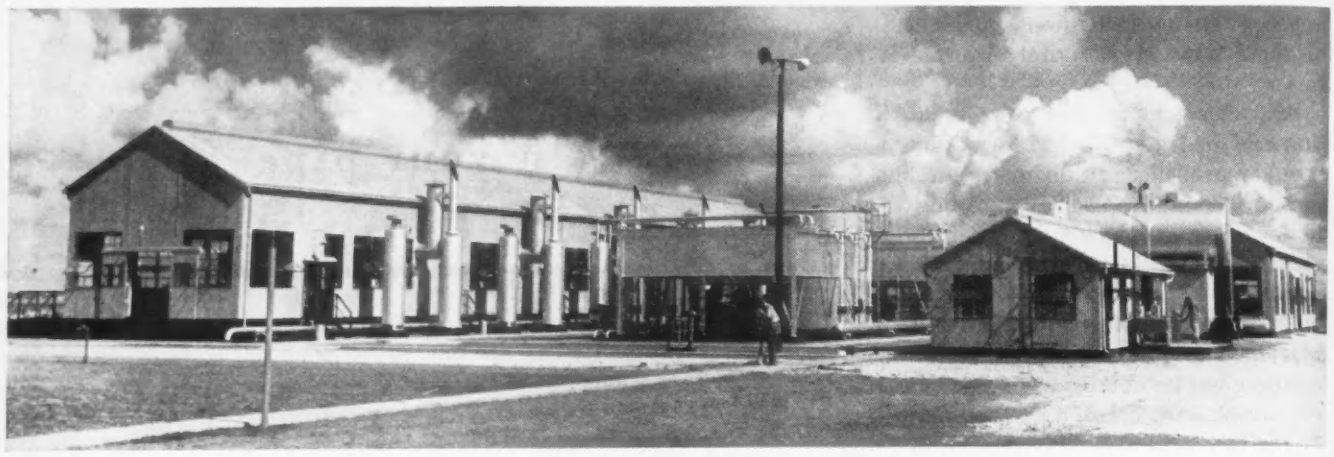

This compressor plant will soon handle 33 million cubic feet of natural gas per day, and is designed for future expansion to have an ultimate capacity of 58 million cubic feet daily.

# Willamar West Field Plant Dedicated

DEDICATION ceremonies held at the Willamar pressure maintenance plant in the Willamar field of Willacy County, Texas, September 6, culminated more than five years of study and planning by the Willamar Engineering Committee which represents 14 different interests.

Judge Olin G. Culberson, chairman of the Texas Railroad Commission, speaking at the dedication ceremony, acclaimed the progress being made in gas conservation in Texas as exemplified by this new, modern project which is expected to increase ultimate oil recovery by about 5 percent. E. R. Turner, president of Pan American Production Company, operators of the plant, presided at the dedication ceremonies attended by representatives of various operators involved, and by William J. Murray, Jr., member of the Texas Railroad Commission as well as part of the Commission's engineering staff. Pressure maintenance operations commenced August 1 when the unitization agreement of the Willamar West field became effective, and flares all over the field were snuffed out as the gas was injected back into the formation to conserve the reservoir energy.

The compressor plant includes many firsts in projects of this kind. It is among the first to incorporate a completely closed air cooling system, and is perhaps the only plant of its kind not associated with a liquid extraction unit in connection with pressure maintenance. Liquid content of the gas did not warrant the construction of an extraction plant. The compressor station has a current capacity of 33 million cubic feet of gas daily, and is designed for future enlargement to handle 58 million cubic feet per day. Six compressors total 6850 installed horsepower, available from five 1100-horsepower units and one 1350-horsepower supercharged unit. All compressor cylinders on the five 1100-horsepower units are sized so that they may be later supercharged in the field without changing cylinders to develop a total of 8100 horsepower.

### Two Main Reservoirs

Casinghead gas is gathered from the Willamar West and the Willamar fields, which are part of an elongated anticlinal structure extending north and south. Three major faults and numerous minor faults divide the structure into two main reservoirs. Gas is taken into the plant at two pressures. The high-pressure system feeds gas into the compressors at 300 pounds per square inch absolute, while the low-pressure system operates at 50 psia. Four-stage compression on the gas compressors makes it possible to accept such a wide difference in feed-in pressure.

Gas is supplied to an injection system at 3000 pounds per square inch absolute, with an interstage pressure of 900 psia for furnishing gas to a separate gas-lift system. The injection gas system has a capacity of 31 million cubic feet daily, while the gas-lift system's capacity is 1.7 million cubic feet per day.

For safety, the plant is equipped with an automatic combined pneumatic and electrical engine shutdown system which grounds the engine magnetos as well as vents the fuel lines should operating conditions change drastically.

The plant, designed and constructed by O. L. Olsen Company, Houston, is laid out so that expansion will be relatively easy, since all buildings, foundations, piping, auxiliaries, etc., will only have to be extended.

A total of 254 wells have been drilled in the area, which has produced slightly more than 21 million barrels of oil. The field is of the dissolved-gas-drive type, having an average gas-oil-ratio prior to time of injection of approximately 2000. Production from the Willamar West field reservoir is from the Frio sand found at an average depth of 7952 feet.

Inauguration of this project shut out all the gas flares in the Willamar field, and under the unitization agreement for pressure maintenance, production methods can better be controlled to obtain a maximum recovery of oil from the reservoir, which when depleted, will contain a large supply of valuable natural gas.

# Procurement Problems and V — Belt Drive Design

Photo Courtesy Allis-Chalmers Manufacturing Company.

Selection of stock V-belt sheaves with standard or catalogued pitch diameter, keyseat, bore, etc., permits stock shipment and quick delivery.


**By J. H. SNARTEMO, Application Engineer**

**Texrope Drive Department, Allis-Chalmers Manufacturing Company, Milwaukee**



**DEFENSE CONTRACTS and the tremendous demand for steel products has placed a burden on many equipment manufacturers. This situation has made it increasingly difficult to obtain special items which require custom tooling. The author outlines several practical suggestions to designers and purchasers to expedite procurement of sheaves. These suggestions do not necessarily involve a change in overall design, but merely a change in ratios so that stock sheaves can be used instead of ordering several specially-designed sheaves which are not in stock.**


THE oil industry is faced with the problem of obtaining reasonable deliveries on all types of equipment necessary to keep pace with the requirements entailed in the expanding defense program. While steel products, notably tubular goods, have received major attention in all discussions of critical items for the oil industry, oil producers and processors as well as pipe line companies are experiencing greater difficulty in obtaining V-belt drives. The demand for variable speed drives has been increasing rapidly and shipments of these special drives cannot always be made in the time required. When such circumstances arise, consideration of the factors outlined below may be of considerable assistance in solving an urgent drive problem.

Generally speaking, anything about a V-belt sheave which departs from stock specifications adds materially to delivery time. A special keyseat, for instance, may entail a reboring operation as well as a setup on the keyseater. These operations usually require additional paper work and a wait for machine capacity. Frequently, a simple offset key would eliminate the need for the special keyseat.

While the fundamental principles of good V-belt engineering are not particularly involved, time and money saving approaches can often be sug-

**TABLE 1**

| V-Belt Size | Range in Pitch Diam. | Range in No. of Grooves |
|---|---|---|
| "A" (½x½) | 2.6" to 18.0" | 1 to 6 |
| "B" (⅝x⅝) | 4.6" to 38.0" | 1 to 10 |
| "C" (⅞x¾) | 9.0" to 50.0" | 3 to 10 |
| "D" (1¼x¾) | 13.0" to 48.0" | 5 to 12 |

gested. Stock sizes of V-belt sheaves are standardized throughout the industry and can be summarized as in Table 1.

These stock sizes cover the great majority of all V-belt drive applications to the extent that both sheaves of the drive can be furnished from stock. However, it is not unusual for competent engineers to work up specifications calling for perfectly good drives employing non-stock sheave diameters when equally good drives could be taken off the supplier's shelf by applying the sheave ratio to the stock sizes available.

If the required driven speed of a drive is such that it cannot be obtained by any good combination of two stock size sheaves, select the larger sheave from stock and have the smaller one made to order. This will usually result in both a cash saving and a faster delivery, since frequently the smaller sheaves can be machined from stock castings or range-type castings carried in stock by the manufacturer. In such cases, the time saved is considerable because present day foundry loads are heavy and deliveries of special castings are consequently slow.

Practically all stock size sheaves are equipped with removable bushings having definite bore limits (both minimum and maximum) which should be considered when specifying the drive. As an example, a five-groove drive might be adequate for the load but call for bushings having maximum bores less than those required. Adding a groove to the drive might be all that would be necessary to obtain stock sheaves with bushings suitable for the bores specified. In all probability, the six-groove stock drive would cost less than a five-groove drive with special sheaves and, in addition, provide better service and longer belt life because of its larger capacity.

Although stock V-belt sheaves were designed to accommodate flange-type straight-bore interchangeable bushings solely for inventory reasons (making possible smaller and more flexible stocks), progressive engineering has developed highly efficient taper-type clamping action bushings which greatly facilitate installation and removal of sheaves so equipped. These bushings are furnished with almost all stock size sheaves at no extra cost and should be a strong incentive for the use of stock sheaves whenever and wherever possible.

A comparatively new factor in V-belt drive engineering is the high capacity or super-rated belts. These belts are credited with a capacity of 1.4 times that of standard belts with the same size cross section. While it is good engineering practice to design a drive for standard belts with the thought that the super-rated belts can be used to increase the capacity of the drive should it become necessary, these super-rated belts can also be employed to reduce the number of grooves required in a drive and so bring it within the stock size range. For instance, delivery time for a 15-groove "D" section drive is apt to be several months, whereas through use of super-rated belts the number of grooves could be cut to 12 and the sheaves obtained from stock.

The demand for variable speed drives has been increasing rapidly and shipments of these special drives cannot always be made in the time required. The obvious answer, in order to get equipment into operation, is to use a constant speed drive made up of stock sheaves and belts until delivery is made of the variable speed drive. Care should be taken in selection of the constant speed drive so that the same set of belts can also be used on the variable speed drive. While use of such a substitute drive involves additional expense, the cost is often small compared to the loss in production which would otherwise be experienced while waiting for the variable speed equipment.


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Looking down into the skimmer to show the location of the various compartments and the excelsior box where the contaminated water is received.

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Principal part of the skimmer consists of a joint of 20-inch pipe about eight feet long, with a segment cut the full length which converted the joint of pipe into a troughlike vessel as shown. Both ends were closed with simple flat heads that were welded water tight to the trough.

A rectangular box, the full width of the open section of the trough and


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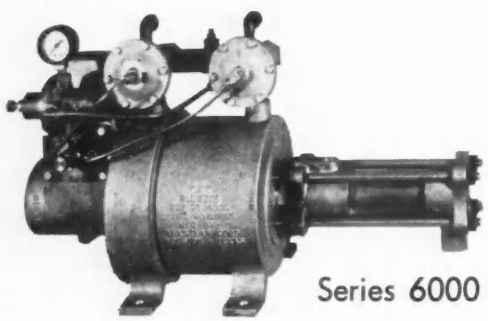

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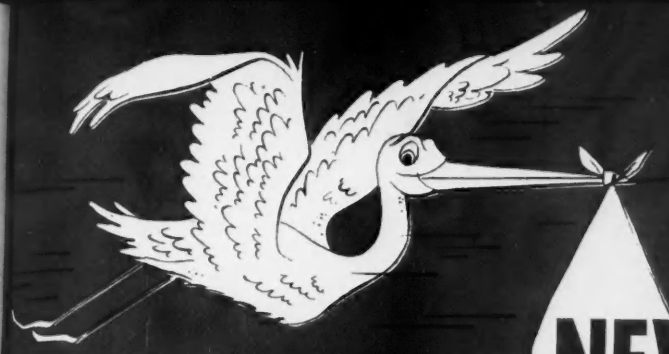

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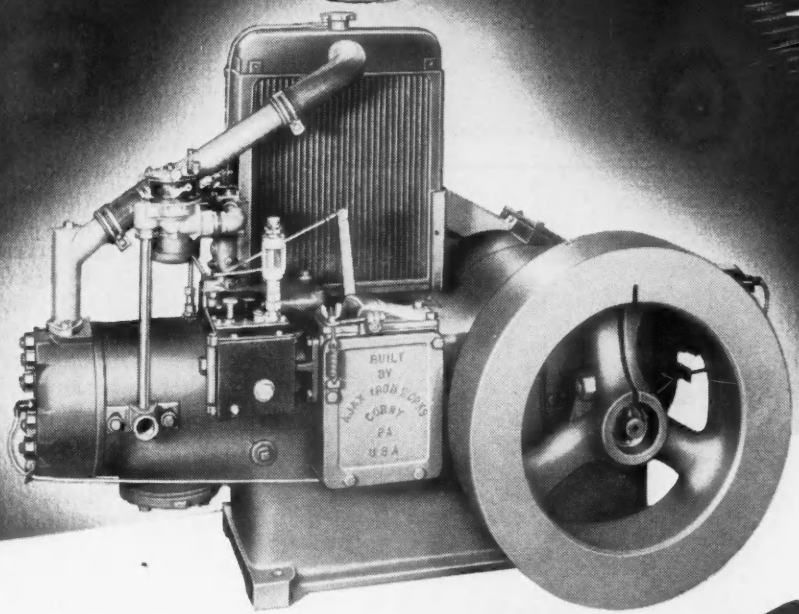


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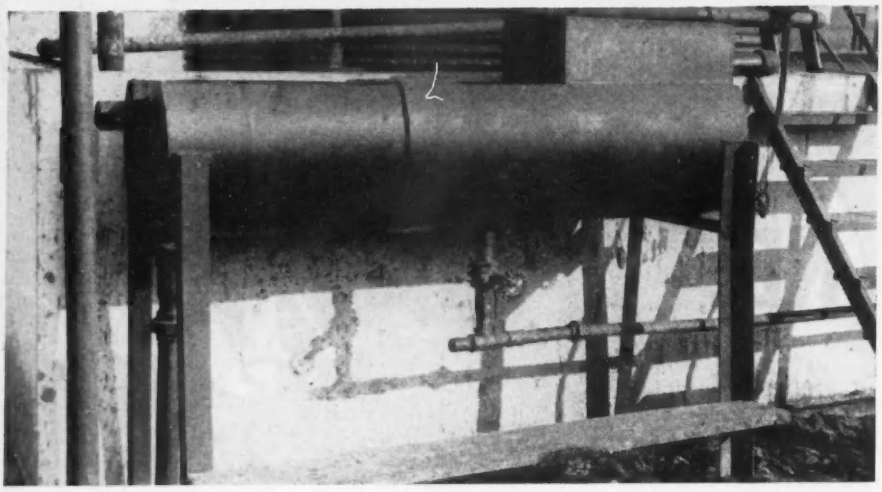

Side view of oil skimmer trough located alongside a gunbarrel tank from which water is received prior to disposal.

about three feet long was welded at one end to the edges of the 20-inch pipe trough. This rectangular box, with a flat bottom, was equipped with a two-inch pipe outlet which permits water to flow freely into the trough below. Excelsior placed in this box serves as an absorbent for oil which may spill over through the siphon from the gunbarrels.

Two lead lines feed water into the excelsior-filled box; one line extends through the flat head to feed water directly upon the excelsior, and the other, containing perforations, distributes the water evenly over the top of the excelsior.

The trough has two separate walls to form three compartments. The first compartment occupys the major portion of the trough and receives both water and oil not absorbed by the excelsior. The second compartment is divided from the third by a lower wall with a V-notch spillway over which the liquid flows into a contaminated water line leading to a sump. Here, the water and the small quantity of oil are periodically pumped back into the original wash tank.

The practically free water in the first compartment, after the oil has been absorbed by the excelsior, but which is further skimmed into the contaminated water line, is bled almost entirely through a drain line attached to the lower side of the trough's first compartment. This is not a difficult problem since the quantity of water produced by all wells is essentially constant. The pumper makes an adjustment on the drain to bleed away practically all of the water, except for the small amount required for skimming.

If there should be a small increase in water production, it would only spill over along with the oil skimming into the sump. Likewise, if there should be a slight decrease in water production, the level in the first compartment would drop only a few inches until another visit by the pumper, who makes a second adjustment on the water drain. The entire unit is mounted on a steel framework beside the concrete firewall where it can be inspected easily by the pumper.

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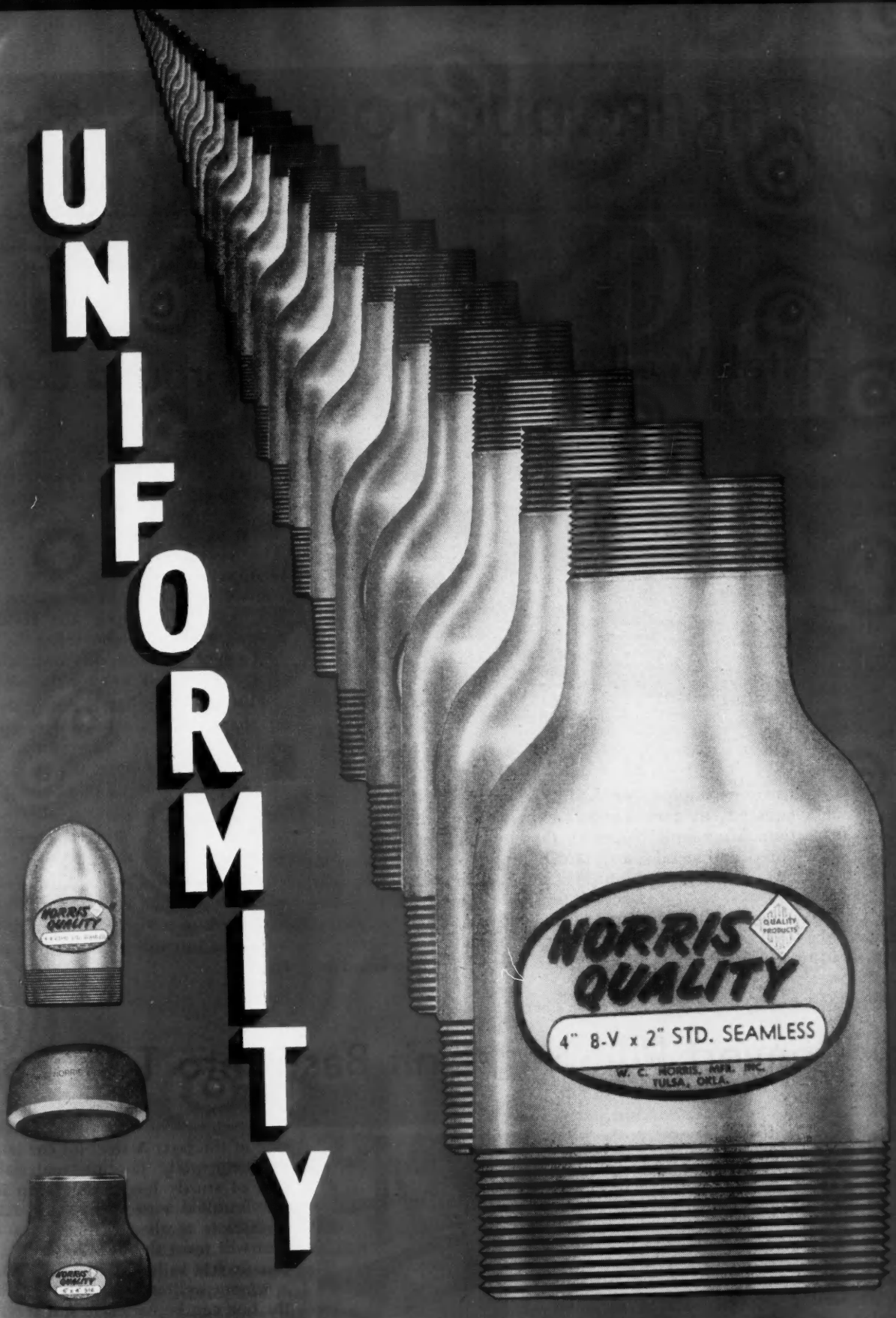


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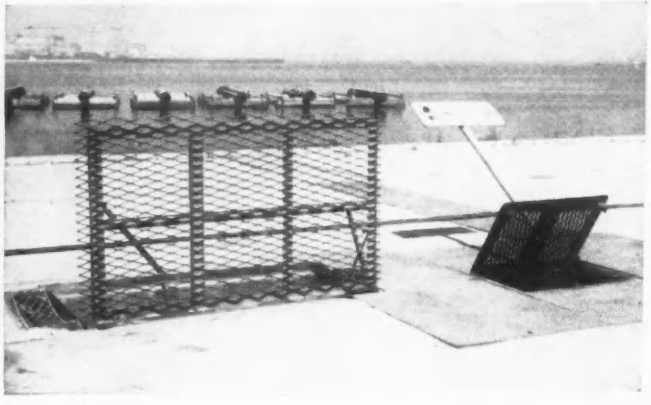
## HOW TO—Install Well Equipment Below Ground Level



In areas where it is necessary for safety and operational reasons to place all wellhead control equipment below ground, a neat installation can be made as shown. In this case, the wells were adjacent to a public thoroughfare and faced an open body of water. A cellar was excavated large enough to house the necessary equipment and provide adequate space for repairing and inspection. Monolithic concrete walls were poured, and metal floor plate and grating were placed at the street level.

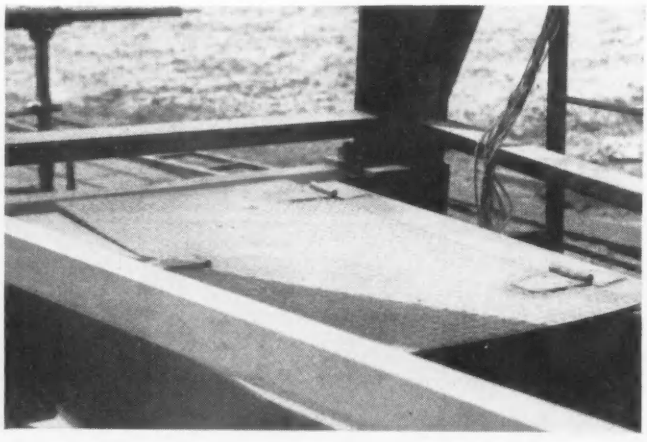
The floor plate could be easily removed in case the well had to be worked over. If instruments or scrapers had to be run in the well, a small hinged, expanded metal cover was opened, thereby minimizing the hazards of dropping tools and equipment into the cellar. The well name and designation are shown on the sign attached to this hinged cover, placed in the center of the floor plate.

Access to the cellar is provided by a steel stairway which is covered by the expanded metal cover shown in the open position. It is counter-balanced to ease lifting the heavy unit. The grating covers provide ample ventilation necessary for such an installation. It is a simple matter for the pumper to open the stairway grating and enter the cellar for inspection of the wellhead equipment to change chokes, or to close the well in.

Floor of the cellar is gently sloped so that liquids (rain water, oil or both) that collect in the cellar may be removed by a sump pump.

While this well installation is somewhat more expensive than normal hookups above ground, it does offer some advantages during the drilling of the well in addition to those gained when it becomes necessary to move in a work-over rig or when wire line tools and instruments must be run in the hole.

## HOW TO—Convert Pumping Unit Base Into Tool Box



A practical, tamper-proof tool box, one that is large enough to hold most of the hand tools, grease gun, oils and lubricants that might be needed at the well or a particular part of the lease, can easily be made by using the base of the pumping unit as the bottom and three sides of the container. Illustrated is the type of storage box that can be put together by the company welder with a minimum of material and labor.

A single, transverse plate is welded across the open end to form the fourth side of the box. A steel lid cut out of diamond plate flooring material, a pair of sturdy hinges and hasp then are installed to complete the transformation of the opening to a box that will resist the light pilfering that usually has to be guarded against on a remote well or lease. The length of the box can be varied to suit the particular needs, it being possible to sectionalize or make longer so shovels and other long-handled tools may be stored in safety.

Such a box easily might take the place of a small building in the early development of a property, and, in any event, would save the hauling of equipment or supplies that might be used only on rare occasions.

# AMERICAN METER COMPANY'S

# New Dallas Plant

## *New Convenience for the Southwest Area*

**You are cordially invited to visit our new plant and showroom at 1300 Industrial Boulevard, Dallas. Designed to specialize in the production of Orifice Meters and related equipment, it speeds deliveries and makes possible a personalized, sales-engineering service including consultations on instrument problems.**

**The new showrooms afford complete facilities for conducting Instrument Schools for engineers and maintenance men. The complete line of American Meter Company products will also be on permanent display.**

AMERICAN METER COMPANY EST. 1836 MEASUREMENT ENGINEERS

**AMERICAN METER COMPANY**

*INCORPORATED (ESTABLISHED 1836)*

GENERAL SALES OFFICE: 1513 Race St., Philadelphia
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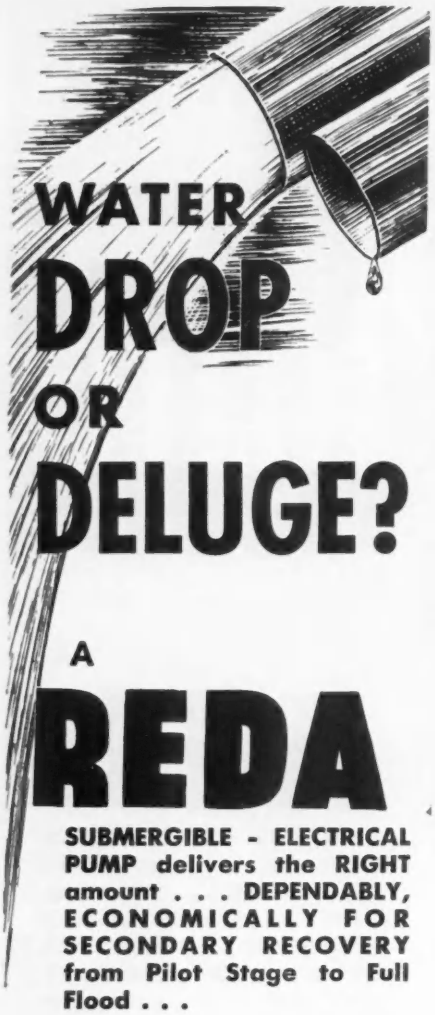


WATER DROP OR DELUGE?

A REDA

**SUBMERGIBLE - ELECTRICAL PUMP delivers the RIGHT amount . . . DEPENDABLY, ECONOMICALLY FOR SECONDARY RECOVERY from Pilot Stage to Full Flood . . .**

**ENGINEERING DESIGN**

Reda Pumps produce the largest volumes obtainable from 5½", 7", 8⅝" casings, often reducing the required number of source wells. Corrosion resistance built into Reda Pumps materially prolongs time between pulling jobs, where corrosion is a factor.

**ECONOMY**

Reda Pumps reduce investment in number of supply wells required. Reda pumping equipment investment is less per barrel of daily capacity; pumping cost per barrel is lower.

**FLEXIBILITY**

To fit the changing needs for water volume as the flood progresses, Reda Pump can readily be altered or changed to larger or smaller sizes.

*Reda Engineers have been closely associated with WATER FLOOD OPERATIONS for more than ten years and are fully qualified to assist operators in the selection of proper pumping equipment. A letter or phone call will bring prompt results.*

**REDA**

**PUMP COMPANY**

•

**BARTLESVILLE, OKLAHOMA**


## PRODUCTION HINTS

# HOW TO—Improve Bailer Dump Box

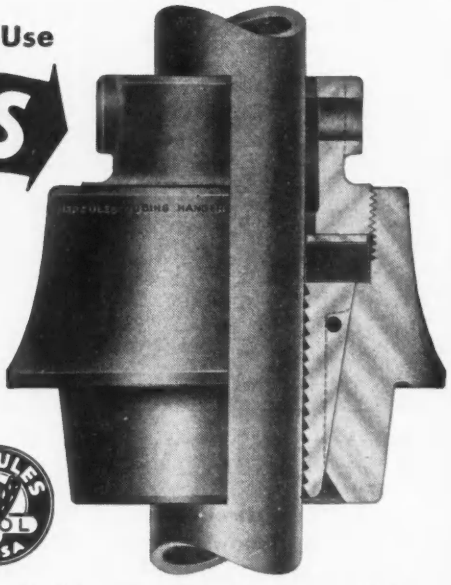
A labor - saving device on a cable tool rig is the bailer dump box. It is found in many forms from rig to rig, and serves to carry away the contents of the bailer into the slush pit. On most rigs, it is permanently located at the edge of the derrick floor, requiring that the floor man push the bailer far to one side so that it can be lowered into the bailer dump box.

The utility and efficiency of such a bailer dump box has been increased considerably by mounting it on wheels. This was done by merely welding an axle across the bottom of the body and attaching the wheels. In doing so, it is a simple matter to move the box near the well opening in the derrick floor so that the heavy bailer filled with liquid and cuttings need only be moved a short distance


**For Complete Protection, Use**

**HERCULES**

**TUBING HANGERS**



**Because of the protection provided, no well should be "put on the pump" without installing a Hercules Tubing Hanger for suspending the tubing. All Hercules Tubing Hangers use the well known Hercules overhead packing arrangement. Made in all sizes to support up to 4" tubing. There is also available a Hercules type RH Hanger with means for packing off around both cable and tubing when used with Reda bottom hole pumps. To assure complete tubing protection, be sure to specify Hercules Tubing Hangers. Write for Bulletin.**

*Sold at all Supply Stores*

**HERCULES TOOL COMPANY**

*Manufacturers of Oil Field Equipment*

**General Office and Plant: 17th and Phoenix P. O. Box 286**

**TULSA, OKLAHOMA**

**Telephone 3-1186 Cable Address "HERTOCO"**

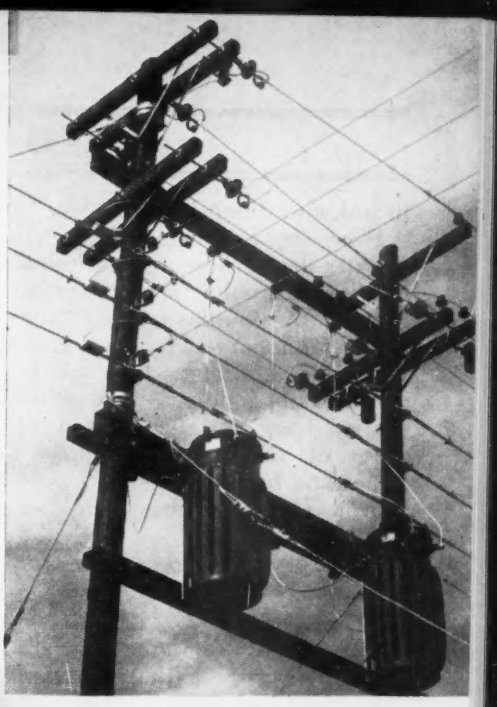
*Export Representative:* **OIL FIELD EQUIPMENT CO., INC.**

T. E. WARD, President

30 CHURCH ST., NEW YORK 7, N. Y.

# You know it's RIGHT

## WHEN BETHLEHEM DESIGNS YOUR LEASE ELECTRIFICATION SYSTEM



The advantages of lease electrification are now so well known that they scarcely need detailing here. But there's one big point we'd like to emphasize: the importance of proper planning and engineering. Plus, of course, the proper choice of equipment.

On both counts, Bethlehem Supply can be of tremendous service to you. Our engineers are men of long and varied experience in the planning of lease electrification. They talk the language, know the facts. They can work in complete harmony with your own personnel, from blueprint stage to the installation of the final pumping unit.

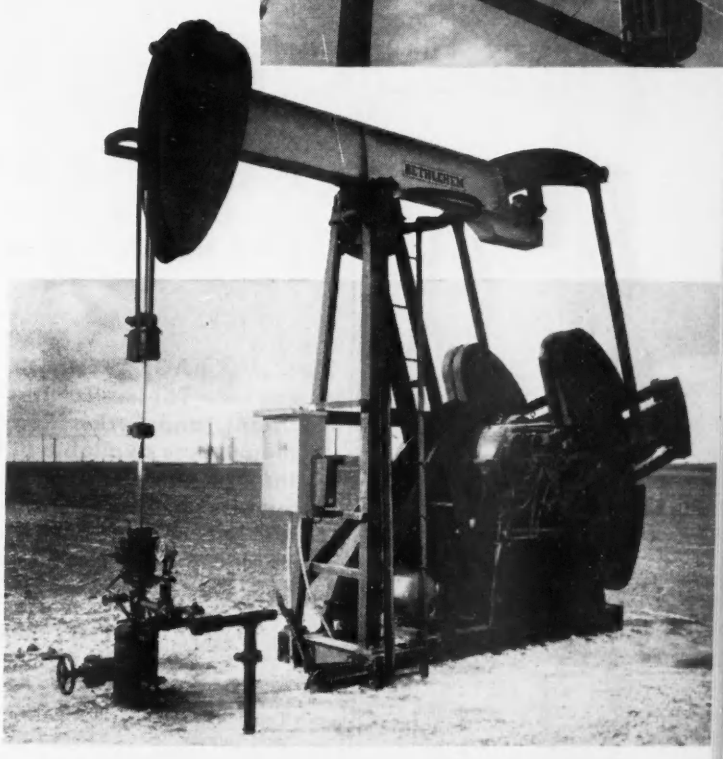
Equipment? Bethlehem handles complete turnkey jobs, supplying every major item needed. For instance:

**GENERATING OUTFITS.** Gas, diesel, or LPG power plants. Engines and generators carefully selected to meet the needs of the individual lease.

**DISTRIBUTION SYSTEMS.** No two alike. Each is planned to take account of local peculiarities, differences in terrain, etc.

**PUMPING UNITS.** Bethlehem has a size and type for every well. Time-clock operation recommended.

**DOWN-HOLE EQUIPMENT.** Includes sucker rods of proper specifications; the right type of bottom-hole pump.



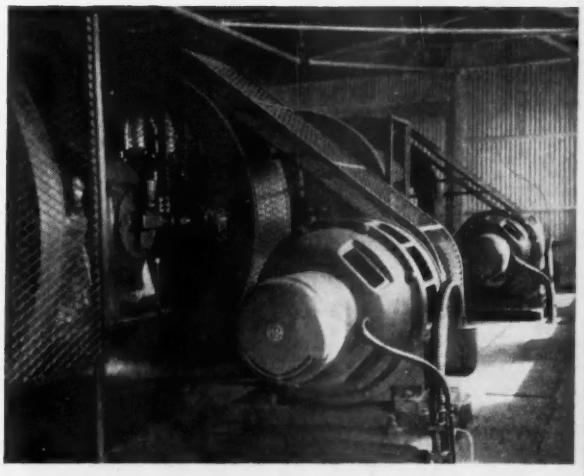
When next planning lease electrification, make use of Bethlehem's solid experience in this kind of work. You'll find we have our feet on the ground, and we'll be glad to co-operate with you and your staff in every way.

BETHLEHEM SUPPLY COMPANY

*General Offices:* 21 E. Second St., Tulsa, Okla.

*West Coast Headquarters:* Los Angeles, Calif.

*Export Distributor:* Bethlehem Steel Export Corporation



*Call us, too, for technical advice on water-flooding service. If you're interested in knowing more about it, we'd like to be of help!*

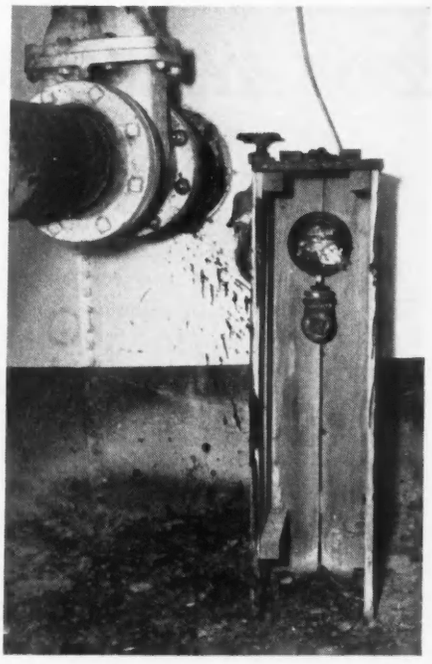
BETHLEHEM STEEL

in order to dump it.

However, this arrangement complicates the discharge end of the box, offering a problem which was overcome in an unusual manner. A long ten-inch discharge line was supported at its open end by a chain and hook attached to a pulley. This pulley is carried back and forth on a short piece of metal rod supported on either end by a timber framework as shown. The supporting chain can be lengthened or shortened to control the height of the discharge line. It is normally held almost horizontal and just above derrick floor level so it can be pulled back to the well opening. When the dumping operation is finished, it can be shoved back to the edge of the floor where it is out of the way. As the bailer dump box moves on the dolly, the pulley follows the metal rod to carry the discharge line with it.

## HOW TO—

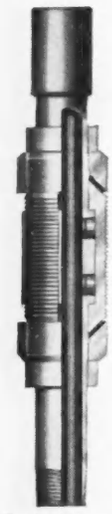
# Maintain Purity of Water for Injection



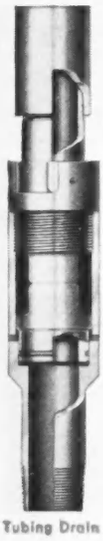
On many water-flooding projects, the water supplied to the injection pumps is carefully protected, not only to maintain purity, but to prevent the entrance of excess oxygen. This can be accomplished by placing a two-foot layer of oil on top of the water. In such cases, it is essential to prevent the pump from drawing in the oil, which not only may emulsify and cause considerable clogging in the injection well, but result in causing an air lock in the injection pump suction.

While many measures may be taken to prevent overflow of the water storage tanks, here is a safety device which prevents the water level in the main storage tank from dropping too low. The injection pump suction is connected directly to the bottom of the tank, and the head of pressure exerted on the suction is determined by the head of water in the tank.

Should the water level in the tank go down dangerously low, due to failure of the water well pump or through an accidental closing of the inlet valve, a mercury type switch is actuated to ground the magneto of the injection pump engine and thereby stop the pump. The mercury switch is connected to a two-inch tap into the lower section of the tank. It is mounted on the vertical opening in a two-inch tee that is blanked off on



Type "B" Tubing Anchor

Type "C" Tubing Anchor


Tubing Drain

On & Off Attachment

PAGE TENSION TOOLS

PAGE

TENSION TYPE

PRODUCTION TOOLS
at your
D + B and CONTINENTAL SUPPLY STORES

PAGE "TENSION TYPE" Production Tools—Tubing Anchors, Tubing Drains, and Sucker Rod On & Off Attachments—are available in the Mid-Continent through your nearest D+B and Continental Supply Stores. Check these new Tools. Get the *full* story on how *Page* Tools can cut production costs by keeping tubing in the hole longer!

PAGE TOOLS ARE *different*

TYPE "B" ANCHOR for ROD PUMP STRINGS: Page Type "B" Tubing Anchors set hydrostatically as the well pumps up!

TYPE "C" ANCHOR for MAIN AND PARALLEL STRINGS: Page Type "C" Tubing Anchors embody the same operation advantages as the Type "B" *plus* a special design for anchoring *both* main and parallel strings!

DRAIN AND BUMPER SUB COMBINED: Page Combination Tubing Drain and Bumper Sub affords a means of draining the tubing above the pump and can also be used as an effective up-jar!

ON & OFF ATTACHMENT for SUCKER RODS: Page's unique On & Off Attachment joins sucker rods to pump *after* tubing run-in—releases quick whenever desired!

FIELD RECORDS PROVE . . .

. . . that anchoring the Page Way *increases* pump efficiency and *decreases* equipment wear —visit your nearest D+B Pump Store or Continental Supply Store – find out how Page "Tension Type" Tools can help *you!*

*Mid-Continent Distributors*

D+B Division—Emsco Derrick & Equipment Co., Garland, Texas

The Continental Supply Company Dallas, Texas

PAGE OIL TOOLS, Inc.
3356 Lime Ave., Long Beach 7, Calif.

# Your needs designed it....

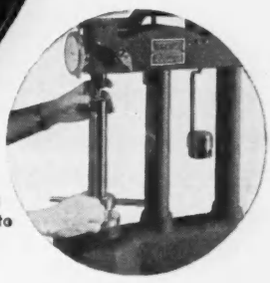
In the Marsh Mastergauge you have a refreshing example of the success that can be achieved by squarely facing a full set of conditions and setting out to lick them one by one.

Your needs — your conditions — designed the Mastergauge line. They are tough conditions — the vibration and pressure surges of drilling; the pulsation of the pipe lines; the extreme pressures and temperatures of the refinery. Sometimes all of these conditions are imposed on a single pressure gauge.

But the Mastergauge is built to meet these conditions all the way. It took the kind of experience Marsh has accumulated in 80 years of instrument making to accomplish this. Just a few of the techniques that have contributed to the outstanding success of the Mastergauge line are illustrated here.

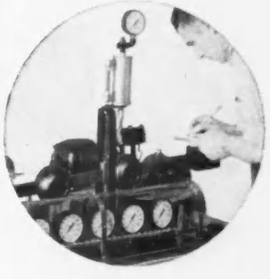
Latest development in the Mastergauge line is the advanced Xmas Tree Gauge. Your supply house wants to sell you these finer gauges.

**MARSH INSTRUMENT CO.** *Sales affiliate of Jas. P. Marsh Corporation,* **Dept. K, Skokie, Ill.**
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Tex.



Here each lot of tubing is tested for hardness to make sure it is up to Marsh standards.

Meshing of rack and pinion magnified 50 times here to check alignment.



Pulsation tests like this have shown the way to make gauges that can take it in the field.

A brutal vibration test — tougher than any field conditions — shows how to make gauges that can stand up in the oil country.

**The Gauge with the "Recalibrator"**

The toughest gauge to knock out of adjustment is the easiest to get back in . . . thanks to this feature — the "Recalibrator."

# MARSH GAUGES

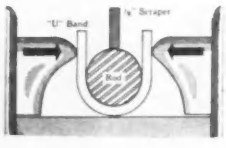
MARSH INSTRUMENT CO.
Sales affiliate of Jas. P. Marsh Corporation, Dept. K, Skokie, Ill.
Houston Plant, 1121 Rothwell St.

# OVER 5,000,000 FEET

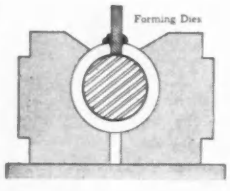
OF SUCKER RODS EQUIPPED WITH

CRALL SPIRAL PARAFFIN Scrapers

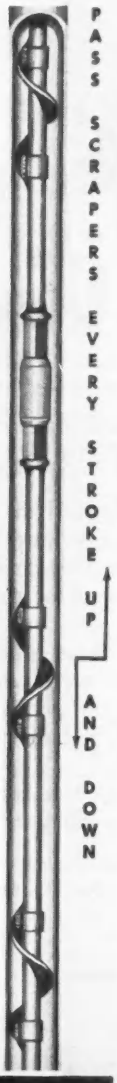
The fact that over five million feet of sucker rods are now equipped with CRALL Spiral Paraffin Scrapers prove that these scrapers are FIRST CHOICE of hundreds of producers from Canada to Mexico. And no wonder! CRALL Scrapers pay for themselves many times over in eliminating stripping and service jobs because of paraffin accumulation.




**Cross section showing "U" band being die-formed around rod to the scraper blades.**




**Cross section showing band held under pressure around rod while ends of bands are shrink-grip attached to scraper blades.**




CRALL Spiral Paraffin Scrapers alternate, one left and one right, eliminating the tendency of the rod to unscrew. They are made of thick, mild steel, and will not harm sucker rods or tubing. They are installed at our fabricating plants on any make sucker rod, and scraper-fitted rods are available at supply stores.

*See your Supply Store or Wire, Phone or Write . . .*

**PETROLEUM SPECIALTY CO.**

P. O. BOX 1640 PAMPA, TEXAS

*Manufacturing, Fabricating Plants and Sales Offices*

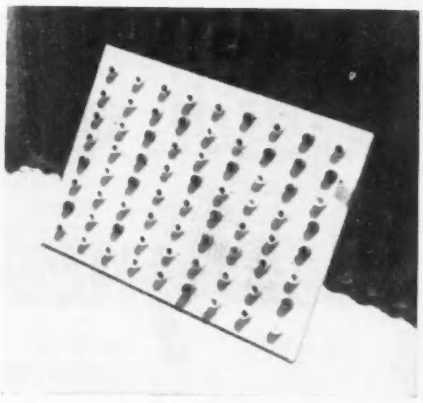
**Pampa, Sundown and Odessa, Texas — Casper, Wyoming — Oklahoma City and Chickasha, Okla.**




one end. The half-inch connecting tube is screwed into a reducing bushing in the tee. This tube connects directly to the helicoid tube which actuates the small mercury bulb. So long as the two electrodes are not emersed in the mercury, the magneto ground is open. However, when the level in the tank drops below a predetermined point, the mercury bulb is tilted so that both electrodes are emersed in the mercury and the magneto is grounded to stop the engine.

## HOW TO—

# Classify and Store Production Chokes



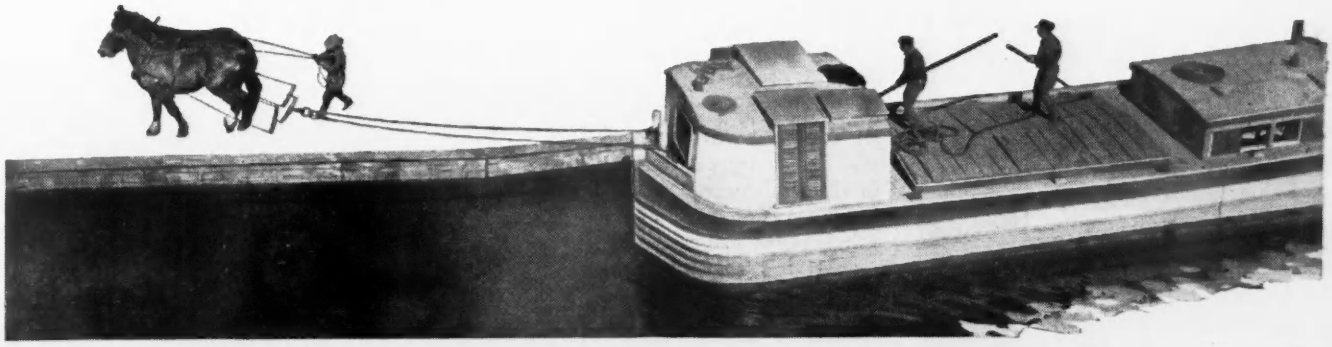
The necessity of changing chokes periodically, as well as installing chokes of varying sizes on different wells makes it essential that a wide variety of production chokes be kept on hand. There is considerable lost motion, and in some cases lost chokes, if a convenient method of storing the chokes is not devised.

Production personnel designed and constructed this handy production choke storage board that not only enables the men to keep track of all chokes on hand, but is arranged to make it possible to select the desired size quickly since the chokes are assorted in vertical rows according to one size.

The board is nothing more than a piece of half-inch plyboard measuring about 20x36 inches, with nine vertical rows of holes cut in the board, and eight holes per row, providing storage for 72 chokes: The type of choke used in this case has a shoulder at one end. The hole is cut in the board so that the main body of the choke will barely slip through until the shoulder engages the board.

Such storage as shown not only provides added convenience in selecting and storing chokes, but it also adds much to their life.

# Now Petroleum Tows the line!



**Petroleum Progress helps keep marine traffic moving**

*Towboats are mostly power plants and propellers. Petroleum provides the essential fuels and lubricants. Many of these are Texaco—which serves shipping the world over.*

TODAY'S marine workhorses are the rugged, little tugs or towboats. These dwarfed, waterborne giants push and pull scows, barges, cargo ships and elegant ocean liners—with infinite ease and tremendous skill—through America's maze of inland waterways, in and out crowded harbors and even on the high seas.

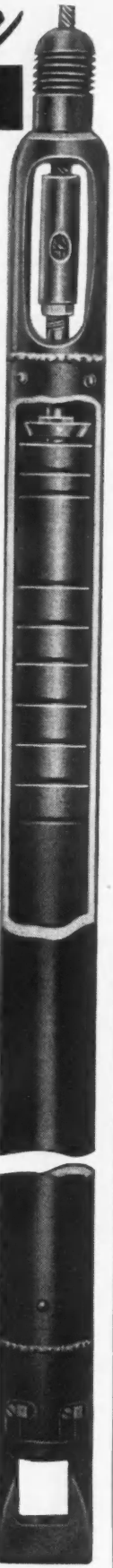
Here is another notable example of petroleum supplying the power that helps keep America on the move—and strong. It also illustrates the progress made possible by free men at work in a land of free competition.

## THE TEXAS COMPANY

***Petroleum Promotes Progress***

TEXACO

# Miller SAND PUMPS



In every major producing area where sand or sediment is a problem, you'll find Miller Sand Pumps and Bailers are standard . . . the leaders in clean-out equipment. For 26 years Miller has held this leadership, with continuous improvements and faithful service.

The Miller Sand Pump is made in regular and heavy duty types in sizes listed below. Lug type, chisel, sand and bailer bottoms are easily interchanged.

**SAND PUMP and BAILER SIZES:**

*Outside Diameters*

2½"
3"
3½"
4¼"
5"
5½"
7"

*Lengths*

20 feet
25 feet
30 feet

**Special Sizes and Lengths Made to Order!**

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue Page 3305 for details.

**MILLER SAND PUMP CO.**

1524 S. E. 29 St. . . . . Box 4516

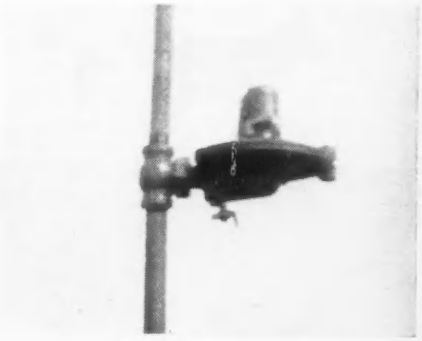
OKLAHOMA CITY 9, OKLAHOMA


## PRODUCTION HINTS

# HOW TO—Drain Pressure Regulator

The common home-type pressure regulator is widely used in the field to reduce pressure on the field gas system to about four ounces for use as fuel in engines of all types. If there is moisture entrained in the gas, it will condense out on the bottom side of the diaphragm of these small regulators. When this chamber becomes filled with liquid, either condensate or water, the regulator not only functions improperly, maintaining a false back pressure on the carburetor of the engine, but the moisture often tends to cause corrosion which results in faulty regulator operation.

In such cases, this liquid may be periodically drained from the bottom-side of the diaphragm to prolong the life of the regulator as well as to insure its accurate operation. An 11/21-inch hole is drilled on the bottom of the regulator near the union connection on the fuel line tee. The



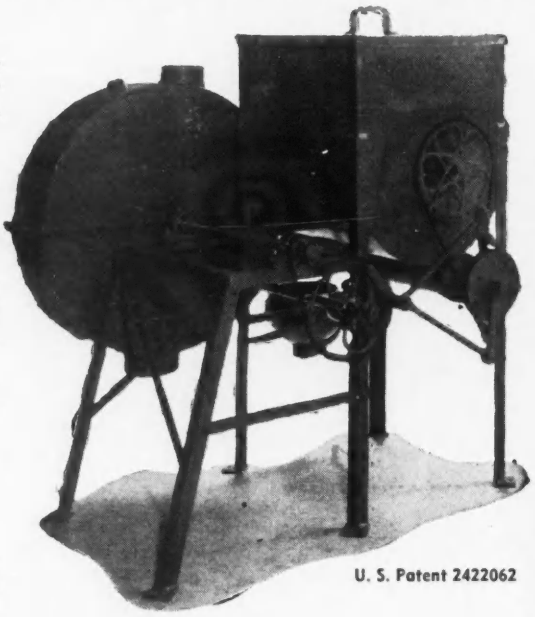
hole is then tapped with an eight-inch pipe tap to form threads. A small petcock is screwed into this opening so the accumulated liquids may be drained as necessary. Pressure inside the chamber forces the liquids out, to maintain the regulator in good working order. This practice has been used in Illinois for many years with excellent results.


THE
# WESTERN CHEMICAL FEEDER
## the dependable, economical water treater

**CHECK THESE FEATURES:**

- Used in Oil Well Water Flooding, Municipal Water Treating Plants, Canneries, etc.
- Can be driven by water entering plant for treatment.
- Maintains pre-set water-chemical ratio through a wide rate-of-flow range.
- Adjustable two ways, to feed from a few pounds to several hundred pounds of chemicals per day.
- Also can be equipped with electric motor, or gas engine drive.
- Made to your specifications in various sizes.
- In use the world over.

*Whatever your water treating problems may be, investigate the Western Feeder. Write for literature and prices.*



U. S. Patent 2422062

**Manufactured By**

# KEYSTONE SUPPLY CO.

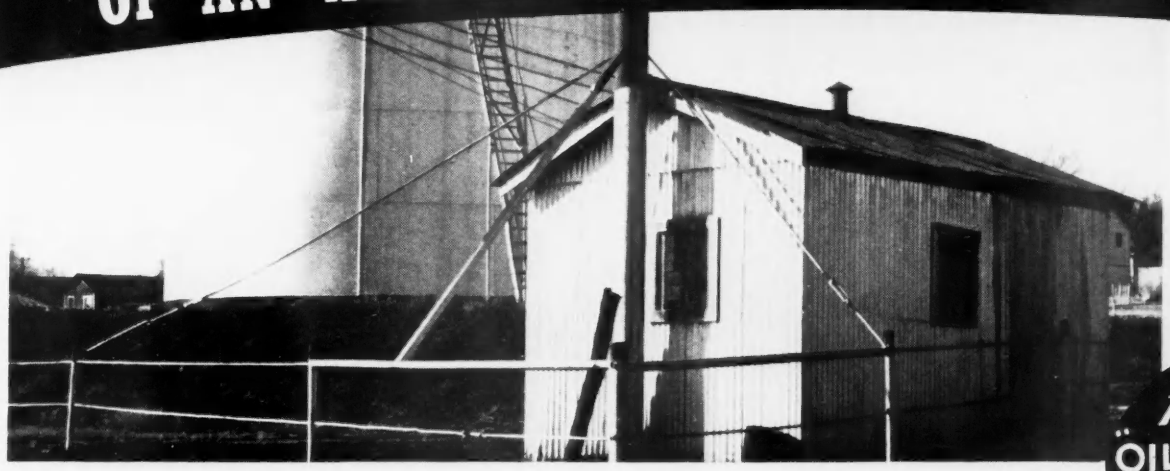
312 E. Cherokee St. NOWATA, OKLA. Phone LD-10

# Pipe Line Section

DONALD M. TAYLOR, SECTION EDITOR

WORLD OIL

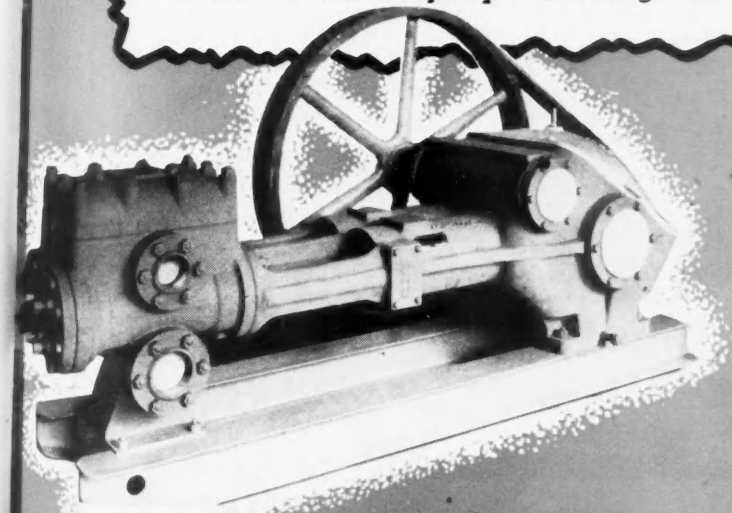

## The Inside Story OF AN AMAZING SERVICE RECORD



from OIL & GAS JOURNAL

### Faithful Automatic Pumping Station

This pumping station of Deep Rock Oil Corp. near Drumright, Okla., has completed its twenty-second year of service. The installation utilizes the first automatic pumping units in Oklahoma, and works by maintaining a proper level of oil in the tank in the background. During the 22 years of operation, a little more than $500 has been spent in repairs, and the station now keeps an average of 3,000 bbl. of crude moving daily from Drumright field to the company's Cushing, Okla., refinery.



*In continuous service since 1928, this Gaso Pump, electrically powered, is still delivering its full quota of dependable performance.*

It is too bad that the picture above (reprinted from Oil and Gas Journal) could not have been taken with an X-Ray camera. If it had, you would see the "heart" of the pumping station that has established such an amazing performance record—a standard Gaso Fig. 1508 pump installed in 1928 and in continuous service ever since. It is performance like this that explains why Gasos are the favorite pumps of pump line men. May we send you a copy of our latest catalog?

**GASO PUMP & BURNER MFG. CO.**

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**GASO PUMPS**

*for every oil industry need*

# 26 MILLION TONS of steel scrap "ain't hay"

IT took 57,000 tons of steel to build the Empire State Building in New York. That's about one-tenth of one percent of the tonnage of scrap required to produce the new steel demanded for America's defense and civilian needs this year.

Half of this scrap is produced by the steel mills themselves. The other half - approximately 26 million tons - must be supplied by the public. That tremendous tonnage is the equivalent of 461 Empire State Buildings - over 1400 carloads of scrap every day of the year.

Right now there is a scrap shortage. It threatens to interfere with steel production. So we appeal to you, as a user of steel and steel products, to do all you can personally to help collect scrap.

Somewhere in your place of business - and even at home - there are things that can be scrapped - worn-out or obsolete machines, pipe, boilers, tools, structural parts, etc., that you'll never use again in their present form. Turn them in through regular channels. Call the nearest dealer and start your scrap on its way to the steel mills - to help America reach its production goal of 105 million tons of new steel in 1951. It is this team-work that will help us win the victory again.

YOUR SCRAP IS NEEDED — YOUNGSTOWN

## The Youngstown Sheet and Tube Company

**General Offices--Youngstown 1, Ohio**
**Export Offices--500 Fifth Avenue, New York**
**MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS**

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

# Practical Preventive Maintenance for Diesel and Gas-Diesel Engines

By J. H. CALDWELL
Engineer, Service Department, The Cooper-Bessemer Corporation

THE higher ratings of modern diesel and gas-diesel engines have made it nesessary to stress the importance of a practical maintenance program. While manufacturers have increased horsepower, lessened weight and improved fuel economy of engines, operators have clung to maintenance programs developed in the days of the lumbering low-horsepower engines.

The modern high output engines are just as capable of trouble-free service as the slow running engines of the past. Difference lies in the heightened tempo of engine destruction which often results when malfunctioning key parts are left unattended.

For example, piston rings on the older type engines could be permitted to blow by for a long period without seriously affecting the engine, because cylinder temperatures and pressures were not sufficiently high to break down lubrication. The same blow-by condition in a modern engine operating at high temperatures and pressures results in rapid ring and cylinder wear and may end in piston seizure if not corrected at the outset.

There are three types of maintenance programs in use today which have disadvantages in operating the higher-speed, high-horsepower engines.

**THE AUTHOR advances an engine maintenance system which eliminates periodic engine tear-downs, which in the past have been guilty of shortening engine-part life. Operators can judge the state of engine repair by noting the changes in exhaust temperatures, lube oil consumption, compression pressures, crank case pressures and other indicators.**

### Progressive Maintenance

Progressive maintenance can best be explained by the following example. Assume that past operating experience indicates that an eight-cylinder engine should be overhauled every 8000 hours. The operator starts out by first stocking a complete subassembly unit; that is, cylinder head assembly, piston, rods with bearings, etc. After the engine has operated 1000 hours, cylinder No. 1 is completely dismantled; the spare unit taken from the stockroom and installed. The engine is again started. The cylinder unit withdrawn from the engine is cleaned and thoroughly inspected for cracks and signs of failure. At the end of the next 1000 hours, the No. 2 cylinder is completely dismantled and the unit that was cleaned is installed. The assembly from cylinder No. 2 is then cleaned and inspected and set aside until the next 1000 hours. The program is carried on until at the end of 8000 hours all units have been overhauled.

The advantage of this type of maintenance is that maximum availability of the engine is realized, but disadvantages far overshadow advantages. In the first place, it is costly because maximum part life is sacrificed. Engine parts which would last for thousands of hours are discarded for new ones to make sure the cylinder will be trouble-free until the next overhaul period.

Another disadvantage of this type maintenance is that there is always one unit which is not mated in. Parts do not reach their maximum efficiency until they have been run together for a number of hours. Obviously one set of piston rings is always breaking in, and one cylinder will always be using an excessive amount of lubricating oil.

The most serious drawback to this program is that it does not guard against serious casualties caused by premature failure of some vital part.

### Periodic Inspection Maintenance

In the Periodic Inspection maintenance program, the assemblies constituting the engine are torn down, inspected, and cleaned after they have been run a specified number of hours. Although this system has advantages and is used extensively by some competent operators, it has many drawbacks. The first of these is needless disassembly of the vital parts of the engine. Removal and replacement of parts still in excellent condition, no matter how carefully done, frequently induces trouble. Perhaps this is caused by simply disturbing parts which have found their optimum running fit or finish.

In tearing down assemblies on the engine, dirt is introduced. This is true even in cleanest of installations. In any operating engine there is always an accumulation of carbon and dirt which collects in places where it does no harm. By tearing into the assembly, this harmless dirt and carbon can be moved to a place where it can do damage.

In setting up the inspection periods, the specified hours between them has been determined by an average established by engine builder's test or past performance. However, a small part deep down in the assembly might fail due to material weakness or previous faulty assembly. Failure of this small part leads to premature casualty for the entire assembly. In this type of maintenance the operator is not free from disastrous casualties because, regardless of the amount of experience both the engine builder and operator have had with the engine, no one can

predict how long a particular assembly is going to last. This type maintenance is also costly because large amounts of materials such a gaskets are used; and, as in the case of progressive maintenance, the parts do not reach their maximum life. Labor involved in carrying out this type maintenance increases the cost.

### Destructive Maintenance

There is a form of maintenance in which the operator runs the engine to complete destruction before making adjustments. All will agree that this is absurd, but it is a fact that engines are receiving such treatment today.

The big disadvantage of the abovementioned programs is that they lack flexibility. The engine builder cannot adopt any one as standard and recommend it to all customers. For this reason, the engine builder, of all people, is left without a plan of maintenance.

### Practical Maintenance Program

The ideal program would incorporate advantages of previous systems along with features which the other systems lack.

These two basic facts relate to all maintenance programs:

- Certain vital parts last longer and operate better if not frequently taken apart.
- Operation until complete destruction is foolish and costly.

Inasmuch as maintenance is the most important factor in successful operation, an answer has to be found.

Thousands upon thousands of hours of operations have proven that 99 percent of all failures are preceded by certain signs or conditions. This basic clue leads to the answer, which is Practical Preventive Maintenance —a program whereby a series of simple tests and observations are used to determine the conditions of vital parts before they are taken apart or fail.

The program reduces to a minimum the forced interruptions of service experienced in other types of maintenance. It avoids unnecessary engine dismantling, and above all is economical in that maximum life of all parts is realized. It also lessens the chances for major casualties. All that is required in this type maintenance are a few simple instruments available in most installations.

The key to the whole program is a daily log used in plotting engine performance. From this log emerge indicators or pointers, which are used to determine the condition of the engine. They are guides to the exact time the engine should be overhauled or adjusted. By following the chart, operators can avert serious engine casualties.

The pointers can be explained by referring to Figure 1, which is a recommended performance log. Note that this log is divided into two parts. The lower half is used for recording test data such as compression pressures, clearances, etc. Included are several daily checks which are not recorded but should be observed. The period at which each test is taken is only a recommendation subject to change in frequency to suit operating conditions.

As with all log sheets, the figures are apparent, but trends and signs of engine distress are hidden. The series of curves on the top half of the log gives the over-all picture at a glance. The horizontal scale shows time intervals, while the vertical scale shows test values.

The upper left hand curve is labeled compression pressure. Readings have been taken every 30 days, and if the piston rings remain in good condition, this curve will remain flat until the engine begins to approach time for overhaul, when the curve will start falling off. This curve gives operators an indication of ring condition.

If conditions are not normal, the engine is headed for premature failure after only 120 days operations as indicated by a decided drop of the dotted line compression pressure curve. This warns the operator that rings are begininng to wear or stick, valves are not functioning, or a liner is beginning to score. Any change in the curve will indicate that the engine needs immediate attention. However, this one indicator or pointer is not the only one which will reveal these symptoms of distress, so, before any action is taken, a quick study of the other curves will either confirm or deny above conditions.

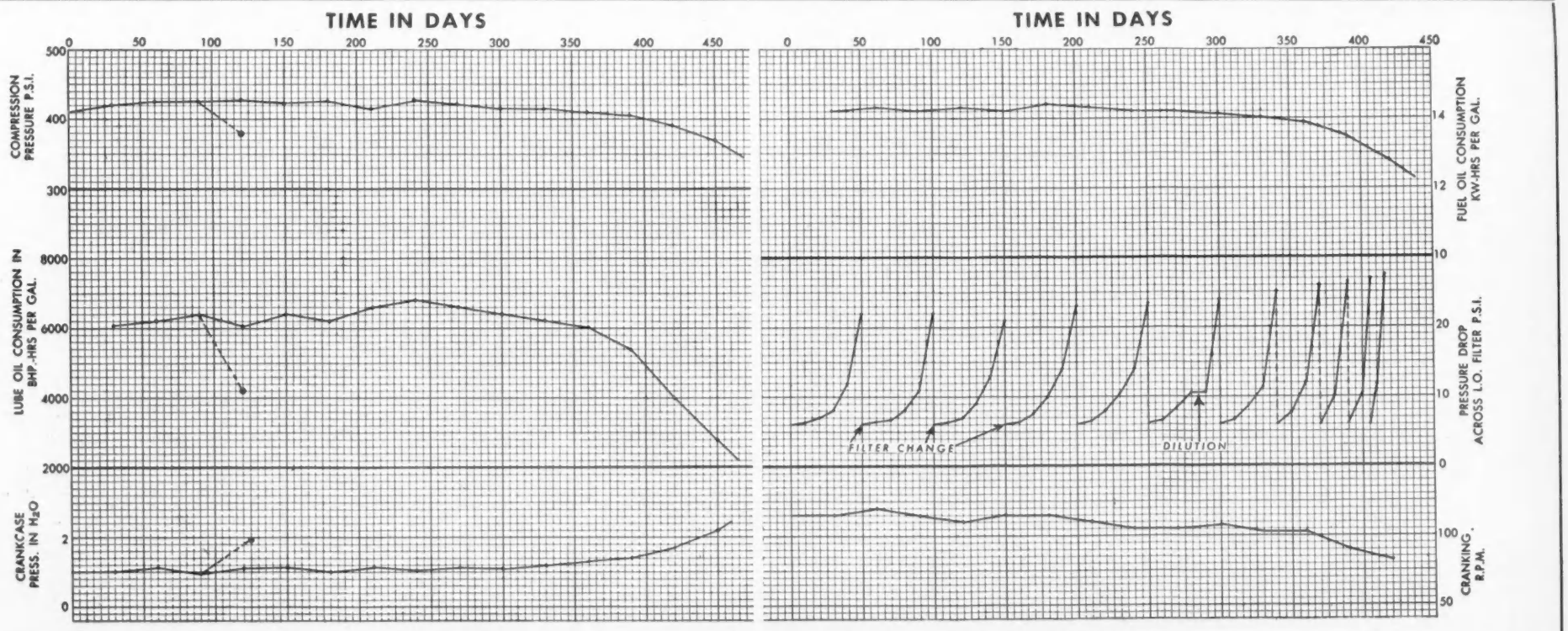
The curve immediately below compression pressure shows lubricating oil consumption, in brake horsepower hours per gallon. Consumption is computed every 30 days and plotted as shown. As in the case of the compression pressure, it remains flat as long as the piston rings are sealing properly. This is particularly true of both the oil and compression rings, because if either fail to function properly, high lubricating oil consumption will result. This curve will have a characteristic flatness until the rings begin to lose life. At that point the curve will start dropping and eventually fall off to a point where it will be uneconomical to operate the engine without a re-ring job. It is significant to note that the downward trend in this curve coincides with dropoff in the compression pressure curve. This confirms that rings are causing the low compression pressure. However, let us refer to the example where a premature failure took place at 120 days as noted by the drop in compression pressure (indicated by the dotted line). If the rings in any one of the cylinders begin to stick or scuff, then a decided drop in lubricating oil consumption (bhp per gallon) will be noticed (as shown by the dotted line in the lubricating oil consumption curve). These two drops in the curves at 120 days confirm that the cylinder in question will have to be pulled because any further operation will result in serious injury to the engine.

If a decided drop occurred in the compression pressure curve, but the lube oil consumption curve did not indicate a sudden drop, the operator would know that rings were not the cause of lowering of compression pressure, but it would be very evident that valves were sticking or leaking badly. Again, referring to the dropoff in compression pressures at 120 days, the operator can also determine the cause of it by removing crankcase doors and turning the engine over on air. If the rings are bad, a hissing noise will be heard in the crankcase. It is possible to pick out the cylinder that caused the drop in compression pressure. However, if the noise in the crankcase is normal, then the operator will know that the low compression pressure is caused by valves functioning improperly.

### Crankcase Pressure

The lower left-hand curve, crankcase pressure, is also an indicator of ring condition. As long as everything is normal, this curve will be flat; however, it is natural that as the engine approaches the overhaul period, blowby will increase. This will result in higher crankcase pressure. It is noteworthy that this curve starts to rise when lubricating oil consumption and compression pressure curves begin to drop, which again verifies that a ring job is necessary. Again referring to the case of premature failure as noted by the dotted lines at 120 days, there is shown sudden increase in crankcase pressure at that time, indicating at least one cylinder is failing to seal.

The fuel oil consumption curve shown in the upper right-hand cor-


TIME IN DAYS
0 50 100 150 200 250 300 350 400 450
COMPRESSION PRESSURE P.S.I.
500 400 300
LUBE OIL CONSUMPTION IN BHP.-HRS PER GAL.
8000 6000 4000 2000
CRANKCASE PRESS. IN H2O
2 0
TIME IN DAYS
0 50 100 150 200 250 300 350 400 450
FUEL OIL CONSUMPTION KW-HRS PER GAL.
14 12 10
PRESSURE DROP ACROSS L.O. FILTER P.S.I.
20 10 0
FILTER CHANGE
DILUTION
CRANKING R.P.M.
100 50

**REMARKS ON DAILY READINGS**

IF ANY CHANGES ARE NOTED IN FOLLOWING READINGS INCLUDE THE REMARKS BELOW: 1—EXHAUST TEMP., 2—PRE-TURBO TEMP., 3—WATER TEMP. TO & FROM ENGINE 4—LUBE OIL TEMP. TO & FROM COOLER, 5—LUBE OIL PRESS. 6—AMT. VAPOR FROM CRANKCASE BREATHER, 7—COLOR OF EXHAUST, 8—SOUND OF ENGINE

ENGINE MAINTENANCE LOG FOR

.....COMPANY.....STATION UNIT NO.....

**WEEKLY READINGS**

| DATE | PRESSURE DROP ACROSS L.O. FILTER | AIR M'FLD PRESSURE | CRANK CASE PRESSURE | CHECK FOR LEAKS | DATE | PRESSURE DROP ACROSS L.O. FILTER | AIR M'FLD PRESSURE | CRANK CASE PRESSURE | CHECK FOR LEAKS |
|---|---|---|---|---|---|---|---|---|---|
| 9 | 10 | 11 | 12 | 13 | 9' | 10' | 11' | 12' | 13' |
| | | | | | | | | | |

**MONTHLY READINGS**

| DATE | COMPRESSION PRESSURES 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | VALVE TAPPET CLEARANCE | L.O. BHP. HRS PER GAL | HOURS OPERATED THIS MONTH | TOTAL HOURS | CRANKING R.P.M. | SEND L.O. SAMPLE | CHECK SAFETY DEVICES | DRAIN MOIST. FROM F.O. & AIR TANKS | F.O. CONSUMPTION KWH/GAL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | | | | 15 | | | | | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| | | | | | | | | | | | | | | | | | | |

**SEMI-ANNUAL READINGS**

| DATE | ROD BEARING CLEARANCES 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | CRANK WEB DEFLECTIONS 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | CRANK SHAFT THRUST | CRANK CASE INSPECTION | CHECK CHAIN TIGHTNESS | CHECK F.O. & VALVE TIMING | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 25 | | | | | | | | 26 | | | | | 27 | 28 | 29 | 30 | |
| | | | | | | | | | | | | | | | | | | | | | |

FIGURE 1. RECOMMENDED PERFORMANCE LOG.

ner is another indicator of general engine condition, particularly the fuel system and rings. Operators should be cautioned not to use this curve for determining condition of the fuel system, because the nozzle can begin to function improperly without much advance notice and if allowed to operate in that condition, serious damage will result. The color of the exhaust stack gases is the best indicator of fuel oil system conditions.

### Pressure Drop

The curve showing pressure drop across the lube oil filter illustrated in the middle right-hand side of the chart affords a great deal of information. The curve applies only to those filter installations that are full flow; that is, the type of filter through which all lubricating oil is passed. When the filter cartridges are cleaned, it will be noted that at zero days the pressure drop is only about six pounds. Each succeeding week, as noted by the small dots in the curve, the pressure drop increases until at the end of approximately 50 days the pressure drop reaches the maximum specified by the filter manufacturer which, in this case, was 22 pounds. At that point the cartridges are becoming clogged and will not pass sufficient lubricating oil, requiring a filter change. The pressure drops back to the original figure of six pounds as noted on the chart.

This curve is a good check on condition of the lubricating oil filter cartridges, and an aid to operators who wish to obtain maximum cartridge without over-contaminating lube oil. Thus, the lubricating oil is always in the best of condition and yet all the available life has been realized from the elements. This point cannot be overemphasized because clean lubricating oil is essential in successful operation.

Another important point revealed by this curve is lube oil dilution. After 280 days pressure drop on the chart was slightly below 11 pounds; after the 290 day reading, the pressure drop was still 11 pounds. This indicates dilution. Under normal conditions, the curve would have a rising characteristic, but impurities in the lube oil reduced viscosity to such an extent that even with more contaminated cartridges, the pressure drop did not rise over the ten-day period. This warns the operator of dilution, and he should immediately look for a leak and correct it before any serious damage occurs.

This curve brings out another important engine trend: it reflects general overhaul engine condition. Every engine accumulates dirt or carbon at a certain rate; likewise, the filter cartridges remove dirt at a certain rate. Under normal conditions, cartridges last about 50 days before reaching the specified maximum pressure drop. When the engine begins to blow-by, approaching the period of necessary overhaul, dirt rate of the engine increases. Inasmuch as cartridges remove dirt at a specified rate, the time beween changes is reduced considerably as overhaul approaches. After 300 days, the cartridge life as indicated, on the chart became less each time until at the 405-day period the engine was manufacturing dirt at such a fast rate that the cartridge life was only about 12 days.

Cranking rpm of the engine has been plotted in the lower righthand corner. This test should be made with air tanks charged to the same pressure and with the engine warm. The curve indicates condition of several engine parts before failure actually occurs. If starting valves are beginning to act sluggish, the cranking rpm will be less, which means the air starting system needs immediate attention. The cause may be dirt in one of the valves or moisture in the system. Nevertheless, the indicator has told the operator of this condition.

A drop in rpm also indicates possible misalignment of the engine. Lacquer on pistons or bearings will cause a decrease in cranking speed.

In carrying out this hypothetical inspection using the pointers, no major assemblies have so far been dismantled. Knowledge of the engine's condition has been obtained without interruptions and dismantling which decreases life of parts. The possibility of faulty reassembly and of getting dirt into the engine has been eliminated.

### How Tests Are Conducted

In performing tests, no effort is made to duplicate values as meticulously as those determined in laboratory tests. In that regard actual values of the test mean little. The important thing is changes in values. Of course, it is necessary to take all tests under the same conditions each time.

Regarding other indicators listed in the lower half of the log, many are self-explanatory. Each of the indicators is numbered. Indicators 1 through 8 are included under the block titled, "Remarks on Daily Readings." Inasmuch as this log covers events over a period of one year, it would be impossible to include actual values of daily and hourly readings on this log; yet they reflect so much on engine condition that a space is provided below these eight indicators for noting changes that take place throughout the year. The ordinary daily log sheets are kept separate and some of the values taken from them are transferred to this engine maintenance log for the purpose of giving engine condition at a glance.

This log is made out for a four-cycle turbocharged engine, but it works as well on two-cycle engines.

Indicator 1, Exhaust Temperatures, is always taken by means of a pyrometer. While the pyrometer is a valuable instrument in detecting faulty nozzles, fuel oil pumps and exhaust valves, it should not be used in balancing engines. Reason for this is evident. In the case of four-cycle turbocharged engines, cylinders are exhausting into separate tubes of different lengths, and all cylinders will have different exhaust temperatures even when the engine is in balance. Before taking exhaust temperatures, individual fuel oil pumps (as in the case of jerk pumps) or distributing valves should be set to deliver equal quantities of fuel.

In the case of two-cycle engines, pyrometers used for balancing have resulted in trouble. For example, suppose the exhaust temperature of one particular cylinder starts to rise. The operator, thinking this cylinder overloaded, then reduces the amount of fuel to that cylinder. What he may not realize is that the ports are clogging up causing a reduction in air and, therefore, increasing the exhaust temperature without any increase in load. Each time the operator reduces fuel to the cylinder in question, he puts additional load on the remaining cylinders. This may cause engine destruction. This has happened many times and pistons, rings, cylinders, etc., have been unduly condemned because of this practice.

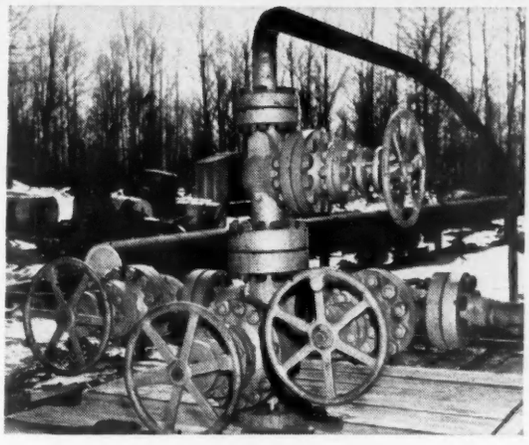
Indicators 2 to 5, inclusive, under Daily Remarks are self-explanatory. Indicator 6, namely Amount of Vapor from Crankcase Breather, is a check or confirmation of piston ring condition as indicated by compression pressure, lube oil consumption, and crankcase pressure.

Indicator 7, Color of Exhaust, is well understood by all engine operators; therefore, we need not elaborate on it.

Indicator 8, Sound of Engine, is one of the most important in Prac-

KEROTEST

# FLOW LINE VALVES



## Here's What Happened!

The above high pressure gas well in western Pennsylvania was equipped with a 10,000 p.s.i. test KEROTEST cross type master valve and matching Kerotest Flow Line Valves. The well was shot and cleaned through these valves and the well closed off at over 4000 pounds pressure without a leak. A water seal poured on the top valve showed not a bubble! This well is flowing 50,000,000 cu. ft. of gas daily with a back pressure of 2300 lbs. sq. in.

**Here's why this KEROTEST Flow-Line Valve is justly famous—**

**It has positive operation—high safety factors.**

**Long-wearing—hard faced wedges.**

**Full opening clearway bore.**

**Safe—extra heavy walls, high tensile bolting, extra deep stuffing box.**

KEROTEST MANUFACTURING COMPANY
PITTSBURGH 22, PA.
New York Chicago Charleston, W. Va. Tulsa Odessa Houston
Los Angeles St. Louis Toledo Richmond Baltimore

tical Preventive Maintenance. It will eliminate casualties if its importance is stressed to all personnel from superintendent to oiler. Each day someone should spend at least ten minutes around the engine to get the "feel" or normal beat of engine noises. This person should stand by each cylinder and actually try to follow the piston up and down. A tight piston or piston pin, a main or connecting rod bearing knock can be detected by someone familiar with normal sound. A few minutes should be spent listening to the blower, crossheads, auxiliary drive, lube oil pump, etc. Once a person has the "feel" of his engine, he can readily pick out defects by paying this daily visit.

### Weekly Readings

Indicators 10 through 13 list weekly readings. The actual values should be recorded each week, and the date should be written in Column 9 for the first 26 weeks, and under Columns 9′ to 13′ for the last 26 weeks.

Indicator 10, Pressure Drop Across the Lube Oil Filter, has been described. Air Manifold Pressure (Indicator 11), in the case of four-cycle turbocharged engines, reflects turbocharger conditions, as well as the cleanliness of the air filter. Reductions in air manifold pressure will result in a dirty exhaust; therefore, its value should be recorded each week. In the case of two-cycle engines, the scavenging air pressure is probably more important because any increase in this pressure will be a certain sign that the ports are beginning to clog. Likewise, a decrease in scavenging air pressure will be caused by faulty suction or discharge scavenging valves as well as a clogged air filter.

Crankcase pressure has been described.

Indicator 13, Check for Leaks, cannot be included as an actual value. However, each week a check mark should be placed in that column to indicate that the operator has checked over the engine.

Indicators 15 through 24 inclusive are included in the block for monthly readings. In regard to Indicator 15, enough has been said about compression pressures; however, the curve was an average of all cylinders for each period, so it is important to record in Column 15 the actual compression pressure value for each cylinder.

Indicator 16, Valve Tappet Clearance, should always be maintained as specified by the engine builder. It is not necessary to record the tappet clearance for each valve, but it is important that they be checked. When the tappet clearance of all the valves has been verified, a check mark can be placed under Item 16. If it is often necessary to adjust the tappet of any one valve, it indicates that there is wear taking place in the valve operating mechanism between the camshaft and the tappet. This includes ball and joints, etc. A faulty push rod crosshead bushing can be detected by any change in clearance as well as scuffed cams or rollers. This can all be determined without dismantling; if the tappet clearance remains constant, then the operator can be assured that everything is satisfactory.

Indicator 17 is used for recording actual values of lube oil consumption in brake horsepower hours per gallon, for plotting the curve as previously explained. To keep the curve from changing direction each month and to make the curve show a flat characteristic for normal operating conditions, it is important that each time the value is figured the lubricating oil in this sump be brought to the same level. This will give an accurate reading rather than an erratic curve.

Item 21, Send Lube Oil Sample to Laboratory, is important. An engine in poor operating condition will soon break the oil down. Likewise, a bad batch of lubricating oil will break down and destroy a good engine in short order. A complete report on the condition of lubricating oil will also confirm the findings of the other indicators included in this log. Although any lab will include remarks in its report, it is advisable for operators to study the booklets distributed by the oil manufacturer to familiarize himself with such tests as neutralization number, precipitation number, viscosity, etc.

Indicators 25 though 30 are included in the block for semi-annual readings. In regard to Indicator 25, Rod Bearing Clearances, the practice of determining this value by use of leads or inspections is not recommended because the bearing has to be dismantled. Many bearing failures are caused by faulty assembly, improper entering of dowels, introduction of dirt either behind the bearing or on its surface, or improper bolt tightening. A properly designed bearing, which will not show wear or fatigue over long periods of normal operation, has failed because mechanics have slipped in the assembly of bearings, particularly those of larger engines, because of the difficulty in seeing how the bearing is being mated when the cap is drawn up. There are several sure signs of bearing trouble. A noticeable drop in lubricating oil pressure indicates excessive main bearing clearances. This is also true, to a lesser degree, in the case of connecting rod bearings. When lube oil strainers and filters show foreign material such as babbitt, the operator should take steps to prevent bearing failure before damage to the shaft begins. The practice of putting a dial indicator on the rod, resting the button against the engine frame or crankshaft and barring the rod up and down, and noting bearing clearances, will determine bearing condition. While it is true that this method does not give a precisely accurate reading of clearance it makes little difference, because it is the change in reading that is significant. In some cases of bearing fatigue the metal spalls off and builds up in one spot. If the clearance as noted by this method decreases, it indicates that the bearing is in distress. If the reading increases above the normal figure, the operator will have to dismantle the bearing for inspection.

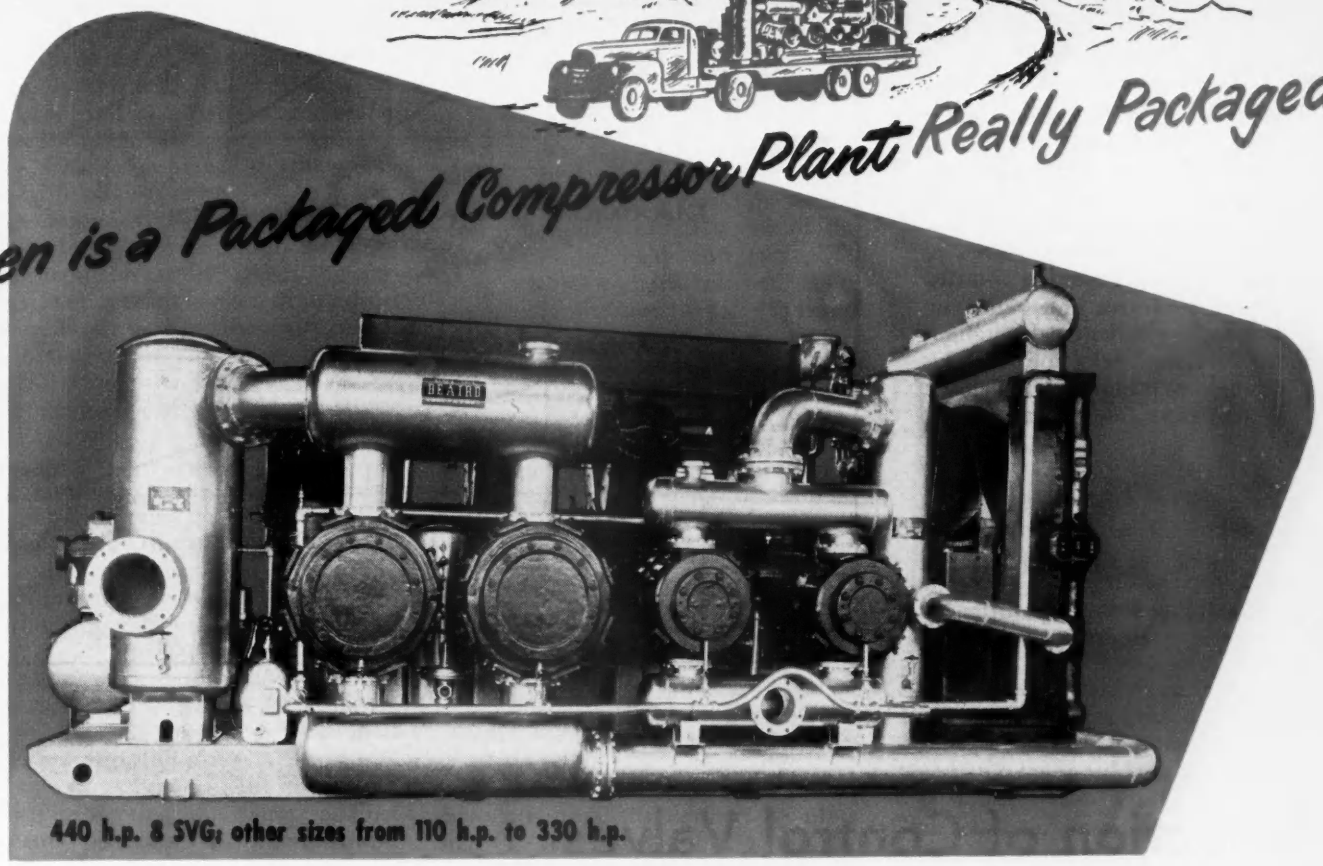
The method described covers connecting rod bearings. In the case of main bearings, taking strain gauge readings at each crank web is a good means of detecting their condition. This value should be recorded in Column 26.

### Crankcase Inspection

The remaining indicators in the semi-annual block are self-explanatory, but, something should be said of crankcase inspection. A thorough check on the condition of the crankcase has eliminated many a serious casualty. All bolts, nuts, cotter keys, and oil lines should be checked for tightness. The backs of all crank doors should be carefully checked, because if a bushing or bearing fails, the particles will be thrown out against the door. The bottom of the oil sump in wet sump engines, as well as the dry sump, should be checked for foreign material. A portion of the liner and piston can be checked for scoring by placing the piston at top dead center when inspecting liners, and bottom dead center for inspection of the lower part of the piston skirt. Rods and piston pins can also be checked for discoloration due to heat.

The Practical Preventive Maintenance program is not too complicated for practical use. Readings and checks are simple and can be used to train all personnel in how an engine functions. The program can also be used to keep supervisors in the main offices well informed on conditions of the engine.

# When is a Packaged Compressor Plant Really Packaged?




440 h.p. 8 SVG; other sizes from 110 h.p. to 330 h.p.

## When *EVERY NECESSARY COMPONENT IS BUILT INTO THE PLANT.*

**The BEAIRD-INGERSOLL-RAND PACKAGED COMPRESSOR PLANT is a complete unit. It includes scrubbers, manifolds, surge tanks, cooling and lubricating systems, air starting equipment, and all necessary connections and controls, as well as the Ingersoll-Rand gas engine driven compressor. The complete plant is mounted on a rugged steel base.**

## When *THE PLANT IS COMPLETELY GAS-ENGINEERED AS WELL AS MECHANICALLY ENGINEERED.*

**Each BEAIRD-INGERSOLL-RAND PACKAGED COMPRESSOR PLANT is custom designed by Beaird process engineers to meet the particular requirements for which it will be used.**

## When *THE PLANT IS COMPLETELY ASSEMBLED IN THE FACTORY.*

**The BEAIRD-INGERSOLL-RAND PACKAGED COMPRESSOR PLANT is shipped as a completely assembled unit, requiring only three connections to put it on stream.**

## BEAIRD - Ingersoll-Rand

### PACKAGED COMPRESSOR PLANT

**FOR USE IN: GAS LIFT, FIELD GAS GATHERING, FLARE GAS COLLECTION, REPRESSURING**

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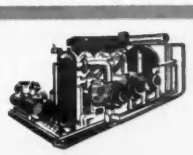

**PACKAGED COMPRESSOR PLANTS**

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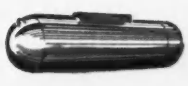
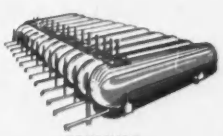


**ANHYDROUS AMMONIA EQUIPMENT**



**PRESSURE BULK STORAGE**

**WHEN PUMP station surge tanks were omitted in favor of the closed system crude and products pipe lines, the main line control valve at each station took on the vital duties of insuring proper suction and discharge pressures and balancing hydraulic gradients, throughout the system. Selection of this equipment is important to closed system pipe line operations.**

By R. H. PUTNAM

Shell Pipe Line Corporation
Houston

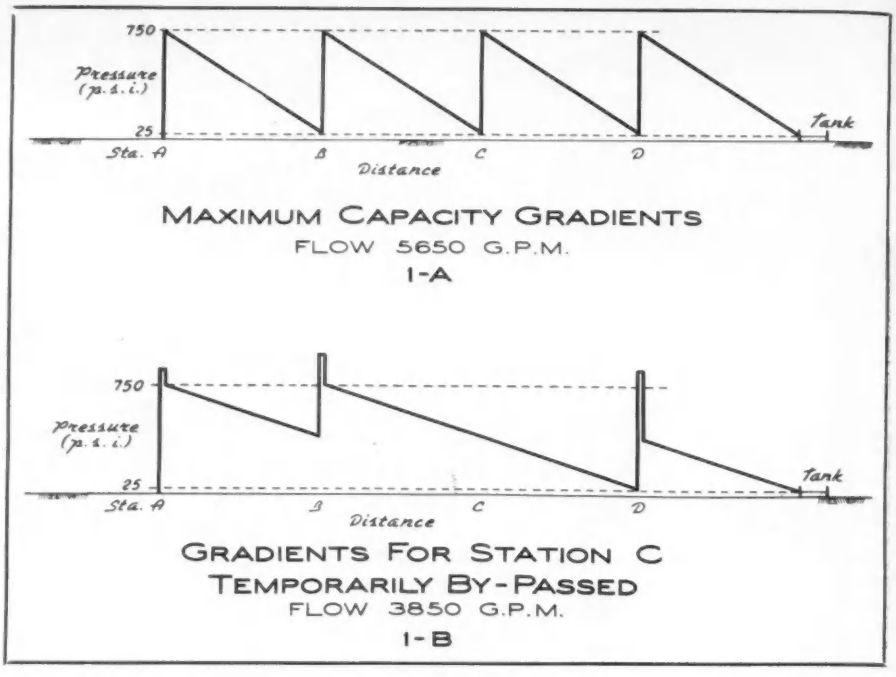



FIGURE 1

# Selection of Control Valves For LARGE CAPACITY Liquid Pipe Lines

PROPER selection of main line control valves for use on crude and products closed system pipe lines can net substantial savings by gaining an over-all increase in product throughput by minimizing system down time.

The problem of selection hinges on arriving at the best compromise on valve port design. This compromise resolves between:

- Obtaining the desired throttling characteristics throughout the range of valve lift, and
- Obtaining minimum throttling loss when the valve is wide open.

If the pipeliner, control valve manufacturer and control instrument manufacturer jointly comprehend and agree on results expected from control installations, a more suitable selection of control equipment can be made to obtain better quality automatic control. A description of the basic fundamentals involved and an illustrative example show the effects of various control valves.

### Hydraulics of Pipe Line Control

The object of automatic flow control on a pipe line is to maintain equal pumping rates at all stations, thus eliminating surge or float tanks on the suction side of each station.

Operation Without Float Tanks

- Makes possible higher suction pressures.
- Prevents float evaporation losses.
- Permits the shipment of more volatile crude or products.
- Reduces contamination between successive products.
- Allows the successful use of high-speed centrifugal pumps that inherently require higher suction pressure.

The apparent effect of automatic pipe line control is to maintain the station suction pressure above a desired minimum and the station discharge pressure below a safe maximum. In accomplishing this apparent effect at each station the controls perform the service of matching the hydraulic gradients on the incoming and outgoing lines, thus equalizing the flow at all stations.

A control valve is necessary in this application since the centrifugal pumps are powered by constant speed electrical motors. The control valve at each station is located on the discharge of one or more pumps all in series, the first pump taking suction directly from the line, discharging into the suction of the next pump, etc., until the last pump discharges through the control valve, finally resulting in station discharge pressure.

The flexibility required in varying flow to limit minimum suction or maximum discharge pressure is accomplished by dissipating a portion of the pumping horsepower in the control valve. This becomes necessary in a properly designed line when one or a combination of the following conditions exists:

- Station start up.
- Liquids of more than one physical characteristic exist in the line.
- The line temperature fluctuates through relatively wide ranges.
- Pumping unit changes are made.
- A complete booster pump station is "instantaneously" de-energized.

During station start up the operating problem of packing the line while bringing it up to normal operating pressures becomes more acute in larger diameter pipe lines. Since the line initially offers comparatively little resistance to flow while the liquid is compressing and the pipe is expanding, the control valve must dissipate a large percentage of the

pumping horsepower in order to keep the pumps full and the motors from being overloaded. This gradually decreases until the percentage loss in horsepower to the control valve is very small compared to that consumed by line friction.

Occasionally lightning knocks a station out of service and, if the automatic controls at the remaining stations are not flexible enough to adjust for the lower flow for the short period until the down station is back on stream, protective high and low pressure devices will shut down these stations with a subsequent loss in pumping time for the entire line.

Figure 1-A shows graphically hydraulic gradients on a four station line at maximum capacity. Figure 1-B represents a temporary condition while Station C is out of service with the control valves at Stations A, B, and D at three different positions since they are providing unequal pressure drops, with Station D requiring the most severe throttling. Station B would require the greatest throttling, but one of its units is shut down by a device protecting the pump against excessive pressure. At Stations A and B the respective control valves are maintaining line pressure below a safe maximum, and at Station D the control valve is maintaining minimum station suction pressure.

Figure 2 shows the system characteristic curves for crude oil flow with combinations of three pumps and 85-mile and 170-mile sections of 22-inch pipe. The Pump Head-Capacity curves represent energy output, while the Line Flow curves represent the energy consumed by the line. At any one condition the difference must be absorbed in the control valve (actually the liquid is heated as it passes through the control valve). The vertical difference between the Pump Head-Capacity curve and the Pressure-Line Capacity curve represents the pressure drop required of the control valve. For example, the line "ab" represents the pressure drop across the valve required when three pumps are delivering 3850 gpm through an 85-mile section of 22-inch line. This would be the condition at Station D in Figure 1-B.

### Control Valve Characteristics

The equation for flow of liquids through a control valve is:

$$Q = KA\sqrt{\frac{Pd}{g}}$$

Where Q = Flow (gpm)
K = Constant
A = Equivalent port area of valve (sq. in.)
Pd = Pressure drop across the valve (psi)
g = Specific gravity of flowing liquid

For a control valve with liquid of constant specific gravity flowing, this equation has three parameters, Q, A, and Pd. In order to study the equation graphically on a two-dimensional plot, it is mandatory that one of the parameters be held constant. To study a valve's characteristics, Pd is assumed constant at 1.0 psi; g is taken as 1.0. For a 1.0 psi drop, with water, the valve equation then becomes:

$$Q = KA$$

The value of KA is the quantity of water (gpm), that will flow through a particular valve at 1.0 psi pressure drop. KA is usually referred to as the valve flow coefficient and denoted as $C_v$. Substituting back in the original equation then:

$$Q = C_v\sqrt{\frac{Pd}{g}}$$

The characteristics of a control valve are usually described by plotting $C_v$ versus valve lift, since the valve port area is a function of the valve lift. Figure 3 shows the approximate variations of $C_v$ with valve lift or plug positions for four types of control valves plotted on uniform coordinates.

With the valve wide open, the maximum $C_v$ can be determined by the quantity of water (gpm) that will flow with a 1.0 psi drop across the valve. In practice, knowing this $C_v$ and the specific gravity of the liquid flowing, the minimum pressure drop across the valve can be calculated for the maximum flow. Likewise, when throttling, if the flow, specific gravity, and pressure drop are known, the $C_v$ can be calculated. From the percentage this is of the maximum $C_v$ the necessary valve position can then be taken from the valve characteristic curve.

### Port Area Change

The shape of the $C_v$-Valve Lift curve actually shows the rate at which the equivalent port area changes as the valve plug is lifted through its stroke. Various types of valve plug construction are used to accomplish a desired rate of area change with stroke. One of the most common control valves used for large flows is the balanced equal percentage V-port plug. The "Equal Percentage Characteristic" may be defined as follows: For all openings of the valve, if the pressure drop is held constant, equal changes in lift will cause equal percentage changes in lift will cause equal percentage changes in the rate of flow through the valve. Also, "equal percentage" means that as the valve

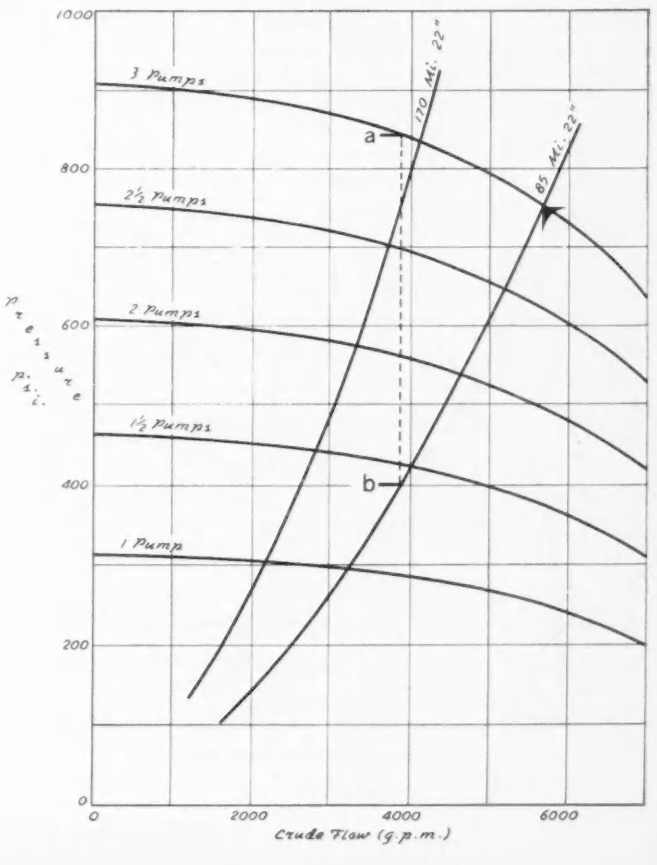



**FIGURE 2.** System characteristic curves.

plug is lifted out of its seat, the exposed equivalent port area increases an equal percentage for equal increments of valve lift. For example, if a 4.2 percent equal percentage valve were opened from 30 to 31 percent, the exposed area at 31 percent lift would be 104.2 percent of the area at 30 percent, and likewise the area at 70 percent lift is $1.042^{10}$ (151 percent) times the area at 60 percent. The $C_v$ versus Valve Lift curve for an equal percentage valve is a straight line when plotted on a semi-logarithmic paper (see Figure 4).

### Sizing Pipe Line Control Valves

The "sizing" of control valves for large capacity pipe line application is quite different from the control valve sizing in process industry, where the control valve should be capable of controlling flow from maximum design capacity to almost shut off, which usually is about 2 percent of maximum flow. In industrial applications the continuous drop across the control valve is at least 15 percent of the system drop, and in many instances exceeds 50 percent. In the case of pipe lines a valve drop of about 10 psi, or 1½ percent of a line drop of 700 psi, is common. The primary duty of the pipe line control valve is flow trimming near maximum capacity in order to keep all the pump stations at the same throughput. If large reductions in throughput are desired for a long period, this is normally accomplished by decreasing the number of pumps operating at each station. Pressure drop is objectionable in pipe line use as it represents throttled or wasted horsepower.

Proper sizing of any control valve requires that the range of flow rate and the range of pressure drop across the valve be known. Fortunately, in pipe line work this information is readily available. The Pump Head-Capacity curve is supplied by the pump manufacturer and the Pressure-Line Capacity curve can be calculated (Figure 2). The Pressure-Line Capacity curve should be calculated for each station since it is affected by the profile.

The requirements of a pipe line control valve are:

- A low minimum pressure drop.
- A fairly constant "sensitivity" and stability through its flow range.
- A time rate of $C_v$ change which permits the valve to follow all system upsets.

The optimum control valve characteristics for automatic pipe line control are illustrated in Figure 5, showing station discharge pressure change per percent lift as uniform, offering ideal sensitivity. For comparison, the characteristic curves of three valves are illustrated, drawn by combining Figures 2 and 4 with three pumps operating on the 85-mile section. As the percentage of output energy dissipated from the pumps is required to transfer from the line to the valve, neither the 4.2 percent nor the 5.2 percent equal percentage valve can hope to compensate in the beginning of its stroke for the large percentage line loss. The change in valve flow coefficient required to make small changes in flow is relatively large. Figure 6 shows the effect of these valves on flow.

Figure 4 illustrates that it is impossible to obtain optimum characteristics. The maximum rate of $C_v$ change theoretically possible is exemplified by the rate of $C_v$ change of a quick opening, or poppet valve, during the portion of its stroke when the valve plug is leaving its seat. By inspection of Figure 4, it appears the 5.2 percent equal percentage valve theoretically approaches this maximum rate between 100 and 95 percent valve lift. To increase the rate of $C_v$ change with lift, and not reduce the maximum exposed port area, the valve is required to accommodate a larger diameter skirt cylinder. By reducing the maximum port area to increase the rate of $C_v$ change, the maximum $C_v$ is reduced. If a valve initially decreases its port area at the rate a quick opening valve does, then it has no remaining area to offer the desired characteristics. These are some of the limitations considered in practical valve design. If the pressure drop across the valve in the wide open position is increased a small amount, the required change in $C_v$ to a new valve position is materially reduced.

To be stable, the control valve must be properly designed to provide adequate driving force throughout its stroke to overcome unbalanced forces due to velocity effects. In addition to the total force necessary to drive the valve plug to its proper position, the incremental forces must be sufficient to maintain this position within the required limits when the unbalanced forces are changing at one valve plug position due to turbulence. It should

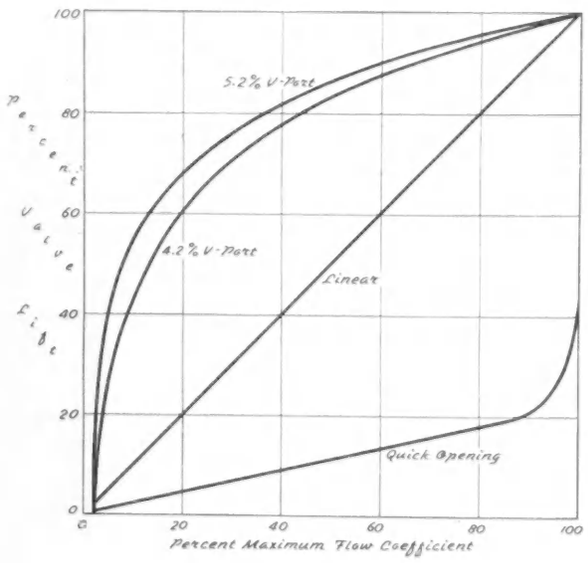



FIGURE 3

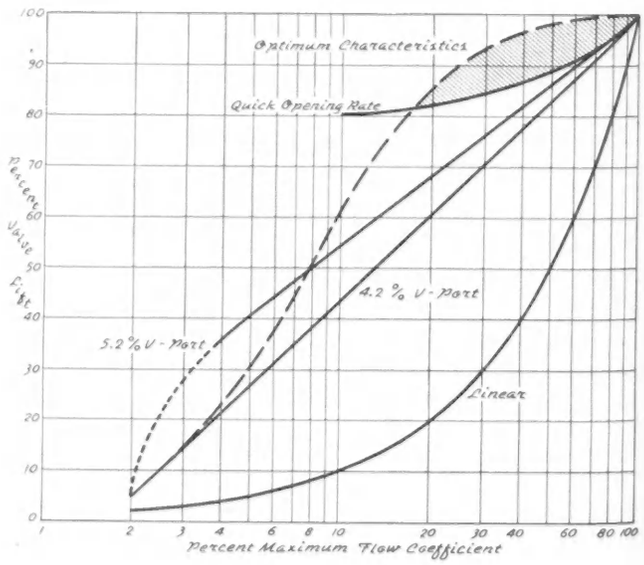



FIGURE 4

Performance curves for various types of control valves.

also be possible to vary this driving force rapidly in order to change valve plug positions quickly.

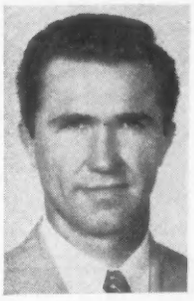
The solution is to find a control valve with a large $C_v$ at 100 percent lift, which will offer as nearly optimum characteristics as possible, be stable throughout its range, and be able to change valve plug positions rapidly. For the valve under consideration, the highest rate of change of $C_v$ practical to maintain throughout the major portion of its stroke was about 5.2 per percent lift. Even this gain was not accomplished without a reduction in flow coefficient. The corresponding data are offered in Table 1.

The advantages gained in control in following drastic system upsets from the 5.2 percent equal percentage valve are considered greater than the undesirable increase in minimum pressure drop over the 4.2 percent equal percentage and linear valves. To illustrate this point, considering Figure 1-B and Station D, to acquire the necessary $C_v$ of 168 at 3850 gpm and 445 pressure drop, the linear valve must move through 93 percent of its stroke, the 4.2 percent equal percentage valve 60 percent, and the 5.2 percent equal percentage valve 45 percent (the optimum valve would have to move through 49 percent of its stroke; however, with a $C_v$ of 1680 it would require approximately 45 percent). The 5.2 percent equal percentage valve is recommended since it can be positioned more easily to follow high rates of $C_v$ reduction required as illustrated at Station D.

It should be pointed out that if the linear type valve were chosen, it would be very difficult for the controlling instrument to perform properly because of the valve's wide range of sensitivity throughout its stroke.

It is hoped that this has shown the need for a thorough study of the problem before a control valve selection is made, and that a corresponding sacrifice in minimum pressure drop must be realized to acquire a high quality of automatic pipe line control.

Although the problem of selecting the control valve has been considered independently, it should be emphasized that the resulting control is interdependent on the effects of both the control valve and the related control instruments; therefore, in completing the selection of the control equipment a careful study of the application of the latest improvements in instrumentation should be included.



## About the Author

R. H. PUTNAM has been on the staff of Shell Pipe Line Corporation's Experimental Engineering Laboratory in Houston since 1949. Born in Lyons, New York, he attended Iowa State College in Ames, Iowa. His schooling was interrupted by one year with General Electric Company and 2½ years military service as a B-17 pilot in the U. S. Army Air Force. He graduated in 1947 with a degree in mechanical engineering and joined Trans-Arabian Pipe Line as a design engineer.

**TABLE 1**

| Valve Characteristic | (Specific Gravity of Crude 0.85) Flow (gpm) | Cv | Min. Pressure Drop |
|---|---|---|---|
| Linear | 5650 | 2300 | 5.1 |
| 4.2% equal percentage | 5650 | 1960 | 7.3 |
| 5.2% equal percentage | 5650 | 1640 | 10.1 |
| Optimum | 5650 | 2100 (arbitrary) | 6.2 |

## Conclusion

With a very large percentage of line loss in series with the control valves, the equal percentage characteristic is best, and on problems involving the selection of large valves such as used on pipe lines, the rate of change of flow coefficient should be as high as it is practicable to manufacture while maintaining a reasonable percentage characteristic throughout the major portion of the lift.

### ACKNOWLEDGMENTS

For the original concept of the paper the author is indebted to J. E. Green of Shell Pipe Line Corporation.

For contributions and criticisms I want to thank R. A. Rockwell, Mason-Neilan Regulator Company; J. G. Kerley, Shell Oil Company; and Russell Milham, The Foxboro Company.

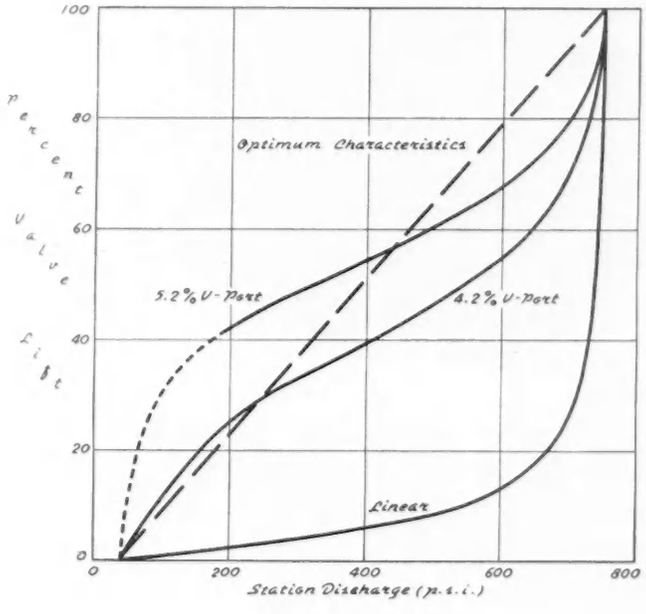



FIGURE 5

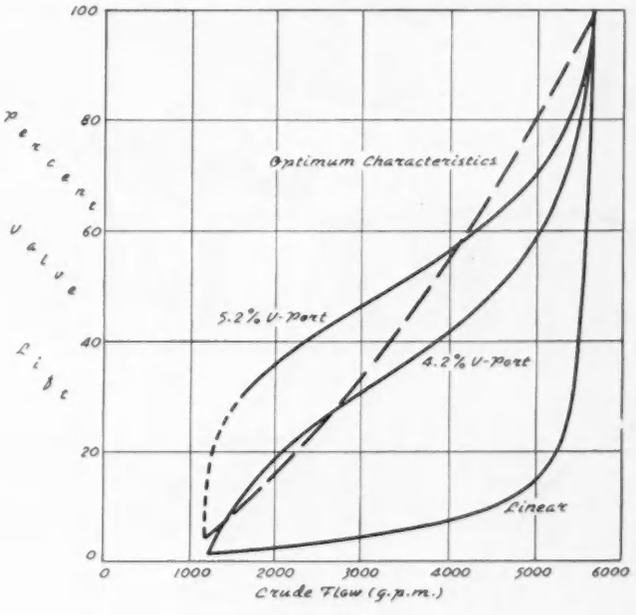


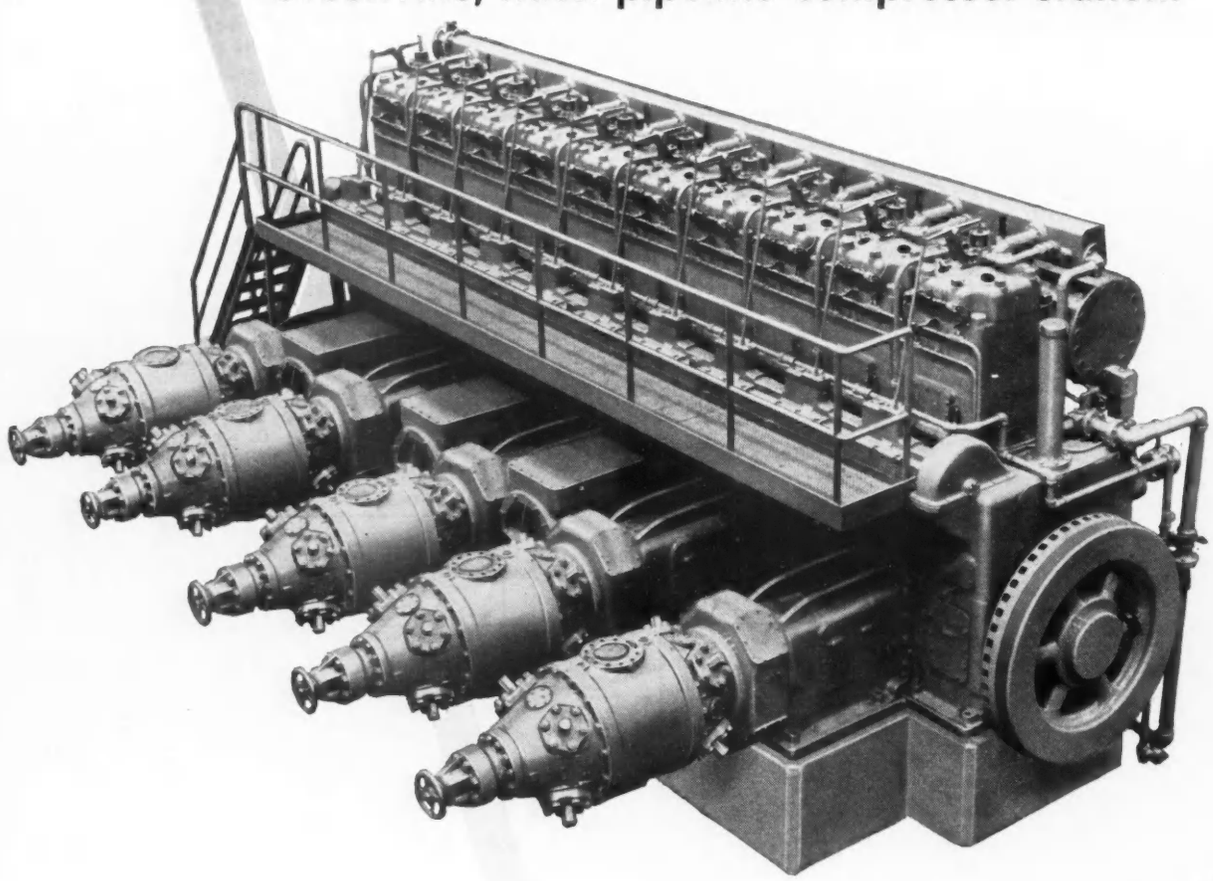

FIGURE 6

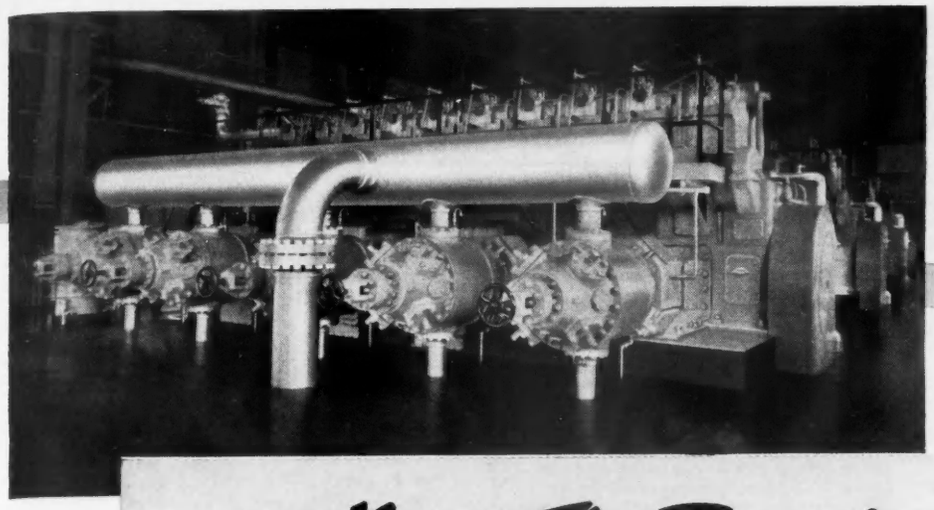
**Performance curves for various types of control valves.**

# *Service Record Verifies*

## LOW MAINTENANCE of CLARK "BIG ANGLE" COMPRESSORS

in Texas Gas Transmission Co.
Greenville, Miss. pipeline compressor station.





Texas Gas Transmission Co. Greenville, Miss., pipeline compressor station consisting of 4 Clark HBA-10 compressors.

## *Here's The Record*

### AFTER FIRST 5000 HOURS' OPERATION

**COMPRESSOR CYLINDER VALVES** —Out of 160 valves, only 5 have been serviced.

**POWER CYLINDER SCAVENGING PORTS**—No carbon formation visible.

**BEARINGS** — No adjustments needed.

**POWER PISTONS AND POWER CYLINDERS**—In perfect condition.

Compressing 400 million cu. ft. of gas, to serve 122 communities, is the *daily* assignment of Texas Gas Transmission Co.'s pipeline compressor station in Greenville, Miss.

. . . and bearing the single responsibility at Greenville are 4 Clark High Compression, 10-cylinder, Big Angle, Gas-Engine-Driven Compressors of 2200 bhp each.

But, the fact that these Clark units passed their first seven months' service with a minimum of maintenance hours and manpower is only half the story. Considerable, initial investment was saved, too, in foundations, piping and the building itself. By reason of the HBA's large bhp in so simplified a design, Texas Gas was able to meet its requirements with fewer units and in a relatively small space.

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# Scaffold Aids in Maintaining Elevated Pipe Lines

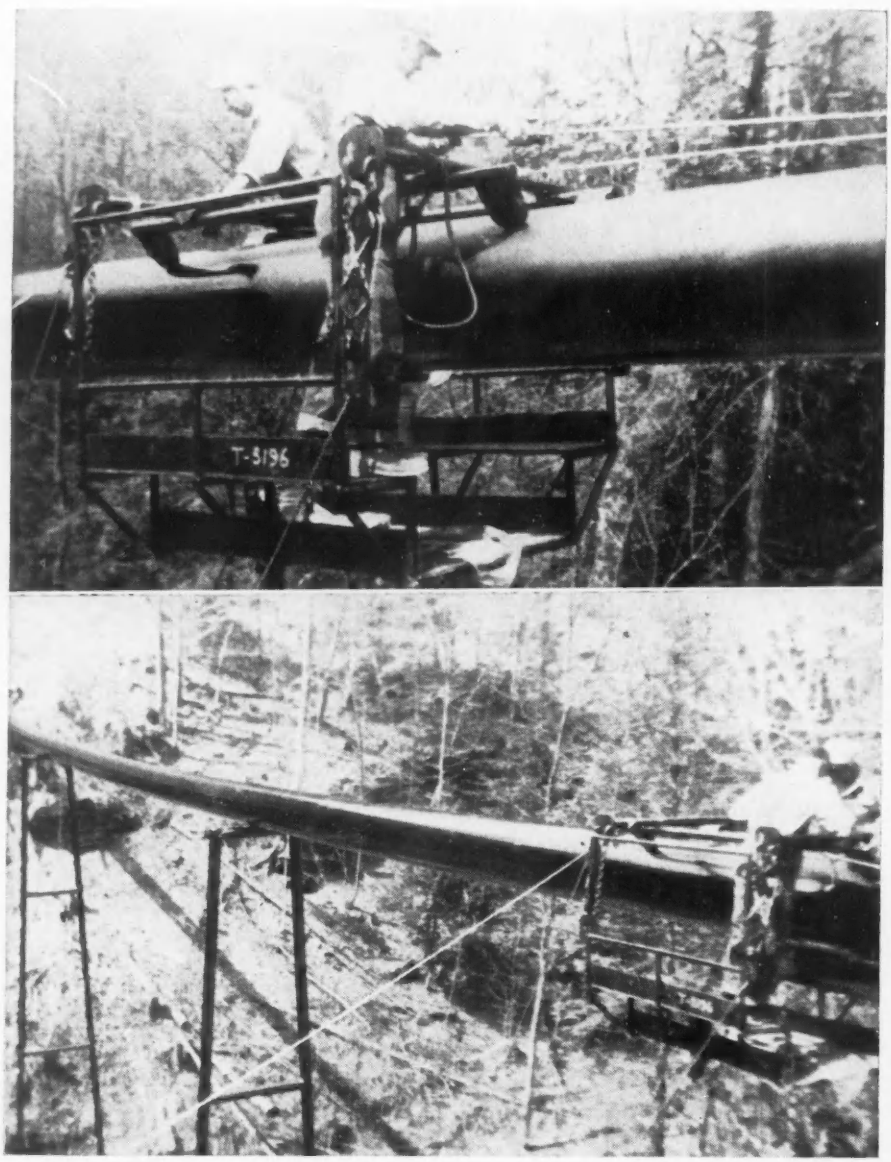
A PAINTING scaffold designed and fabricated by two Tennessee Gas Transmission Company employes takes most of the danger out of painting and maintaining elevated pipe lines. Made of small diameter pipe and wood, the lower section of the platform is attached to an upper framework which moves along the pipe line on rubber-tired rollers, providing workmen with a substantial footing and guard rail while they paint high above the ground.

This platform, designed by C. B. Thompson, District 14 pipe line superintendent, and fabricated by Clarence Moore, District 245 pipe line superintendent, is a great improvement over rope slings often employed in painting elevated lines. To use this scaffold, workmen place the rollers or casters of the upper framework on the pipe line, where it is at a convenient elevation, and pull it out to the area to be painted. Then by means of block and tackle attached to four corners of this upper framework, the bottom section of the scaffold, with painters in it, is hoisted aloft. When the two sections join, the painters couple them with chains, and begin their work. As painting progresses, crew members on the ground pull the scaffold along the pipe.

To fabricate the upper section of the scaffold, eight-inch rubber-tired casters are welded to the ends of two 6½-foot lengths of 2⅜-inch pipe with the rollers parallel to the pipe. A pair of 5-foot, 10-inch lengths of 2⅜-inch pipe are welded across these two runners in such a manner that the castors incline 45 degrees toward the center line, and the ends of the cross pieces will overhang the line pipe. Thus, a rigid framework which will roll down the pipe is formed. A three-eighths-inch steel plate cut six inches square is welded to ends of the cross members. Holes burned in the plate serve as eyes for hoisting block as well as for chain hook used to support the lower section of the scaffold.

A frame for the lower section of the scaffold is made from one-inch pipe as shown in the accompanying illustration. The decking is made of five-eighths-inch plywood and 1 x 6 boards. Over-all height of this section of the scaffold is 4 feet, 10 inches. Plates welded to the framework corners about midway up provide a means of attaching the hoisting block and the chain support which holds this section of the scaffold to the upper section during painting operations.

The scaffold is readily demountable, and can be easily transported to and from the job. When not in use it takes up little storage room.




**After painters complete their work aloft, crewmen on the ground raise the bottom half of the platform a few inches with the block and tackle. Painters remove chains from the four corners, and crewmen lower the platform to the ground. The upper framework can be pulled along the pipe to a convenient elevation for removal.**

# PIPE LINE *Construction*

By CECIL W. SMITH, WORLD OIL Staff

## Projects Announced and Contracts Awarded

### *Crude Lines*

**Continental Pipe Line Company** has received approval from the Petroleum Administration for Defense for a 225-mile 12-inch pipe line to run from Wichita Falls, Texas, to Ponca City, Okla. The line will have a daily capacity of 40,000 barrels and will serve Continental's Ponca City refinery.

**Continental Pipe Line Company** now has PAD authorization for 100 miles of 8-inch pipe to be laid from the Rincon field, Starr County, Southwest Texas, to a marine terminal at Port Isabel. The line will be built by way of McAllen. Rice Institute, Houston, is a 50 percent partner with Continental in the venture.

**Pan American Pipe Line Company** plans to build 15 miles of pipe line from the Hulldale field, Schleicher County, West Texas, to the proposed Rancho system that will run from McCamey to Houston.

**Service Pipe Line Company** has requested bids on 30 miles of 6-inch pipe line to be laid between the South Haskell field, Haskell County, and the North Knox City field, Knox County, North Texas. The line will tie into the Jud-Bowie line now being built by Service.

**Service Pipe Line Company** has awarded contract to C. L. Rogers Construction Company, Wichita Falls, Texas, to take up and recondition 23 miles of 10-inch pipe in Platte County, Wyoming, that comprised a part of the company's Wyo.-Mo. trunk line.

**West Texas Gulf Pipe Line Company** will construct a 20-inch line from Wortham, Freestone County, East Central Texas, to Longview, East Texas. The line will connect the company's proposed "Big Inch" to Mid-Valley Pipeline Company's system at its southern terminal at Longview. (Correction: Mid-Valley was previously listed as the proposed builder of this line.)

### *Natural Gas Lines*

**Atlantic Seaboard Corporation** has received FPC authorization to build one 3520-hp compressor station in Randolph County, W. Va., on its Cobb-Rockville 26-inch carrier.

**Central Kentucky Natural Gas Company** has been authorized by the FPC to lay 18 6/10 miles of 12-inch loop lines between Winchester and Lexington, Ky. This section will complete the looping of the existing 10-inch line from Menifee to Lexington.

**Chicago District Pipeline Company** has applied to FPC for permission to lay 15 miles of 30-inch pipe from the Texas Illinois Natural Gas' system near Elgin, Ill., to the Public Service Company of Northern Illinois line.

**Cities Service Gas Company** has petitioned FPC for a permit to build 5½ miles of 6-inch line from a point near Olathe, Kans., to the Food Machinery & Chemical Corporation plant in Johnson County.

**Cumberland and Allegheny Gas Company** applied to FPC for 35 miles of 10-inch line to run from Mountain Lake field, Md., to Manufacturers Light & Heat's system on Penn.-W. Va., border in Monongalia County, W. Va. Included in the application were 11 miles of pipe line to be laid in Garret County, Md., and Preston County, W. Va., and two compressor stations. These would be 880-hp and 1200-hp stations in Garret County, Md.

**Georgia Gas Company** has asked FPC for permission to build 32 miles of 4-inch pipe line from Transcontinental's line near Bogart, Clarke County, Ga., to Gainesville, Ga.

**Home Gas Company** made application to FPC for 17 miles of 12-inch loop lines to be built in Delaware and Broome counties, N. Y.

**Hope Natural Gas Company** made application to FPC for permission to lay 5 6/10 miles of 8-inch line from the Terra Alta field, Preston, W. Va., to the proposed line of N. Y. State Natural Gas at the Va.-Md. state line.

**Mississippi River Fuel Corporation** has received FPC permission to build 16 2/10 miles of 12- and 24-inch feeder and withdrawal lines in the proposed Waterloo storage field, Monroe County, Ill.

**Montana Power Company** has awarded contract for 52 miles of 16-inch line to be laid between the Canadian border and a point near Cut Bank, Mont., to Engineers Limited Pipeline Company, San Francisco. This is the U. S. section of a line from the Pakowki Lake gas area of Alberta, Canada, to Montana.

**Montana Power Company** awarded to O'Connor Contracting Company, Dallas, a contract for the laying of 15 miles of 8-inch and 23 miles of 6-inch line from the Hart Mountain field, Wyo., to Warren, Mont.

**Natural Gas Storage Company** applied to FPC for a certificate to construct 12¼ miles of pipe line and one 6000-hp compressor station in connection with a proposed underground gas storage area in Kankakee and Iroquois counties, Ill. Only 6½ miles of line are intended to be laid initially, and the compressor station would be ultimately increased to 32,000-hp.

**New York State Natural Gas Corporation** has received authority from FPC to build 35 2/10 miles of 20-inch loop lines and a 6600-hp station at Dryden, N. Y. The pipe will be laid between the proposed compressor station and the Therm City station. Pipe line construction will not start before 1953 and one-half of the power in the station will be added in 1952 and 1953.

**New York State Natural Gas Corporation** asked FPC for permission to lay 8 miles of 8-inch line from the Mountain Lake field, Md., to the proposed line of Hope Natural Gas at Md.-W. Va. state line

**New York State Natural Gas Corporation** applied for a PFC permit to build a 3080-hp station in Leidy Gas field, Clinton County, Penn.

**Ohio Fuel Gas Company** has been authorized by FPC to build 61 miles of line in Erie, Lorain, Warren, Montgomery, and Madison counties in Ohio.

**Ohio River Pipeline Corporation** applied for FPC permit to build 10½ miles of 8-inch pipe line from Texas Gas' 26-inch line east of Louisville, Ky., to the Ohio River. The application includes two 8-inch river crossings and 1½ miles of 8-inch line on north bank of the Ohio River to Utica, Ind.

**Texas Eastern Transmission Corporation** awarded contract for the Ohio River crossing on Ky.-Ohio border to Pentzien, Inc., Omaha. Williams Brothers Company, Tulsa, has been awarded a contract for crossing of Ohio River on Ohio-W. Va., border. Both crossings are part of company's 791-mile 30-inch line from Miss., to Penn., now building.

**Texas Gas Transmission Corporation** has been granted temporary authorization by FPC for construction of its "South Louisiana Supply Lateral". This lateral will consist of 189 miles of 26-inch line extending from Acadia Parish, South Louisiana, to company's system in Morehouse Parish.

**V-M Pipeline Company** applied for FPC permission to build 7 4/10 miles of 4-inch line from Texas Illinois Natural's line to the B-V Pipeline Company's line near Vandalia, Ill., and 8 4/10 miles of 4-inch from the Trunkline Gas Supply's line to Metropolis, Ill.

## Projects Starting

### *Crude Lines*

**Gulf Refining Company** started laying 88 miles of 14-inch line between Lumberton, Miss., and Mobile, Ala. This is a section of the Eucutta to Mobile line, and Anderson Brothers Corporation, Houston, is the contractor. Sixty-four miles of 10-inch were started earlier by L. E. Farley, Inc., Houston.

**Humble Oil & Refining Company** has N. A. Saigh Company, Inc., San Antonio, laying 63 miles of 14-inch line from Pledger field, Brazoria County, Texas Gulf Coast, to its Baytown refinery. The contractor got job underway in the latter part of August.

### *Product Lines*

**Imperial Oil, Limited,** started its 188-mile

10- & 12-inch line from Sarnia, Ontario, Canada, to Toronto during September. Comstock Midwestern Ltd., Leaside, Ont., has the contract and will build the Sarnia-London 12-inch leg first. The London-Toronto 10- & 12-inch section and Hamilton 6-inch spur will be started in the early part of 1952. Comstock has the Sarnia pump station underway.

**Phillips Petroleum Company** have let contract for 101 miles of 8-inch loop lines to Brown-Lite Company, Tulsa, and for 73 miles 8-inch to Somerville Construction Company, Ada, Mich. These lines are to be laid between East St. Louis and East Chicago, and both contractors started during September.

**Canadian Montana Gas Company** started laying 18 miles of 16-inch line from the Pakowki Lake gas area to the Canada-Mont., border. This is Canadian section of Pakowki to Mont., project. Canadian Pipe Line Construction Company, Ltd., Edmonton, is doing the job.

**Cities Service Gas Company** in August had Cheek Construction Company, Ulysses, Kans., start work on 129 miles of 4- through 22-inch gathering system in the Hugoton gas field, near Ulysses, Kans.

**Colorado Interstate Gas Company** in August started laying 30 miles of 20-inch pipe line from Elbert County to Limon, Colo. Pipe is being laid by R. H. Fulton & Company, Lubbock, Texas.

**Kansas Power and Light Company** started the laying of 30 miles of 20-inch line between Calista and Pratt, Kans. M. E. White Company, McPherson, Kans., is the contractor.

**Northern Natural Gas Company** recently had Bills & Toth Construction Company, Tulsa, start laying 20 miles of 16-inch line in the vicinity of Plattsmouth, Neb.

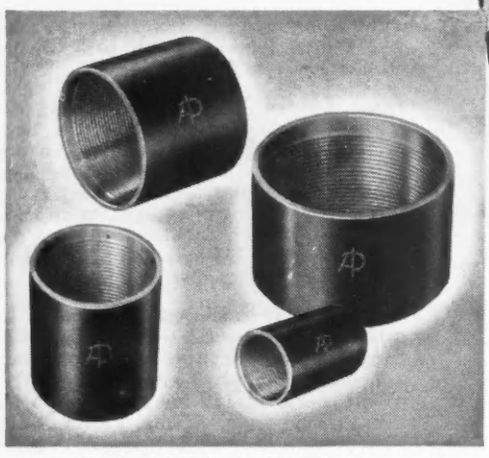
**Pan American Gas Company** is building 40 miles of 16-inch pipe line from Winnie, Jefferson County, Texas Gulf Coast, to Texas City. Anderson Brothers Corporation, Houston, has the contract and started work during August.

**Rochester Gas & Electric Company** has started the laying of 15 miles of 22-inch line between Scottsville and Rochester, N. Y. Harford Brothers Company, Emporium, Penn., is doing the work.

**Southern Natural Gas Company** has started laying 33 miles of 24-inch loop lines in Ouachita and West Carroll parishes, North Louisiana, and 7 miles of 24-inch loop in Sharkey County, Miss. Associated Pipe Line Contractors, Inc., Houston, are doing the work.

**Texas Gas Transmission Corporation** awarded contract for 181 miles of 26-inch line in Louisiana to Houston Contracting Company. Contractor has three spreads on the job and all got started during September. The South Spread is working on 56 miles from Eunice to the Red River. The Central Spread has from the river to Grayson, a distance of 60 miles, and the remaining 65 miles from Grayson to Beekman, La., is being done by the North Spread.


"Since I was a boy—darned near.."



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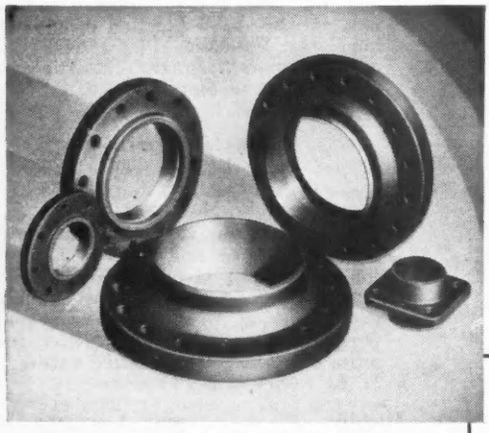

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## Projects Completed

*Crude Line*

**Pan American Pipe Line Company** has recently completed a gathering system in the Hulldale field of Schleicher County, West Texas.

*Product Line*

**Petroleos Mexicanos** has completed a 155-mile 10-inch line from its Minatitlan refinery at Veracruz across the Isthmus of Tehuantepec to Salina Cruz, Oaxaca, Mexico. The first 47 miles were built by Pemex crews, but the remaining 108 miles were constructed by Gonzalez Ballesteros, S. A. and Compania Constructora El Aquila, S. A. This new line will have a capacity of 30,000 barrels daily when it is put into operation, and it is the first ever to be built across Mexico to serve the West Coast.

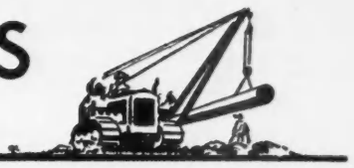
*Natural Gas Lines*

**Panhandle Eastern Pipe Line Company** has completed a 130-mile 30-inch looping project in Illinois and Indiana. Conyes Construction Corporation, San Pablo, Calif., was the contractor.

**Trunkline Gas Supply Company** has completed its 1205-mile 20-, 24- & 26-inch system running from McAllen, Southwestern Texas, to Tuscola, Ill. The project was completed ahead of schedule and deliveries should be made soon as stations are nearing completion. Pipe laying contractors on the job were: Houston Contracting Company; Anderson Brothers Corporation; E. J. Mahoney Contracting Company, Lansing, Mich.; R. H. Fulton & Company; and Fulton & Brodie Construction Company, Lubbock, Texas.

How to do it!

# PIPE LINE HINTS



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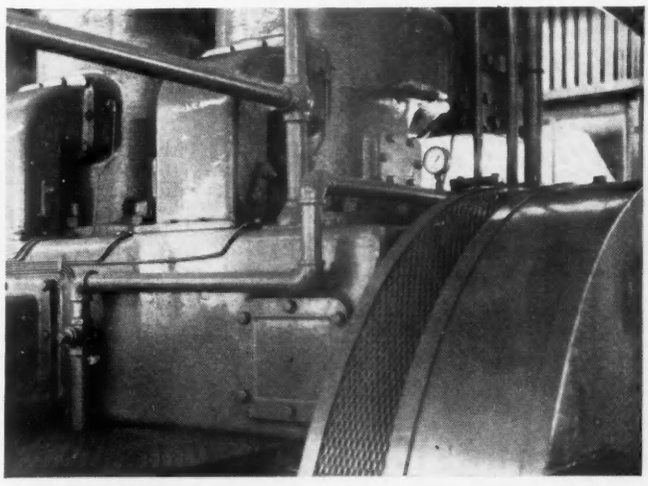
## HOW TO—Dispose of Oil Vapors from Crankcase



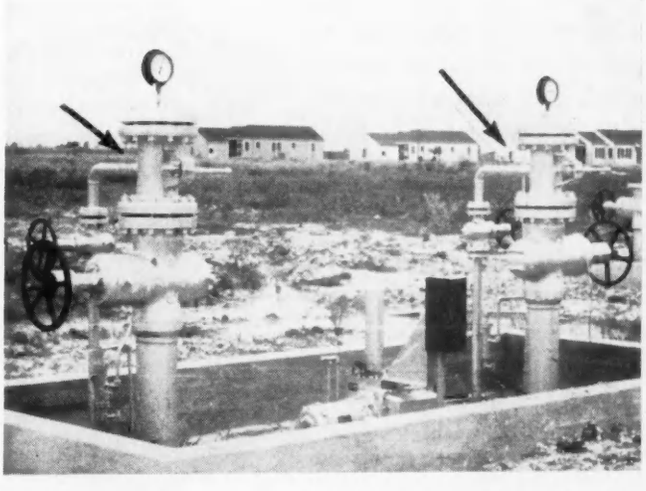
Piping oil vapors from the crank-case to the engine air intake can eliminate oil condensation inside the building and provide slight additional lubrication of engine power cylinders.

In the past, most engine crank-cases were vented through piping running outside the building or through breather caps inside the building. Regardless of the efficiency of breathers, condensation took place when oil vapors from the crank-case mixed with raw atmosphere. Deposits of the oil condensate created safety hazards, causing floors and walkways to become slick and because the mixture is inflammable. Additional maintenance was required to remove the oil from building walls, walkways and engines.

The problem was solved by piping the breather outlet to the scavenger cylinder air intake. The oil vapor entering the scavenging air is carried to the power cylinders where it is burned along with the engine fuel. A slight amount of upper cylinder lubrication probably results from this arrangement.

Because of the low pressure on the scavenger cylinder intake, it is necessary to mount a throttling valve between the breather and the connection to the air intake. This permits operator to adjust pressure inside the crank-case.

## HOW TO—Tap Pipe Line for Station Fuel Supply



One company saved money by eliminating hot taps when supplying fuel gas for a compressor station erected after the pipe line was in operation, by installing tapped spools on suction and discharge blowoffs.

The two spool sections, shown in the accompanying illustration, were shop fabricated from heavy-wall eight-inch pipe. Two 600-pound slip-on flanges were welded to the ends of 16-inch lengths of eight-inch pipe nipples. A length of two-inch pipe with 90-degree weld ell and flange was saddled into the eight-inch pipe. On the side opposite the two-inch saddle, a one-inch coupling was welded to provide a bleed-off.

After fuel-gas piping was completed from the blowoffs to meter building, the blind flanges on the suction and discharge blowoffs were removed and the spool pieces installed. The blind flanges were made up on top of each spool piece, and the two-inch connections were bolted to the two fuel gas valves.

Ordinarily the fuel gas for the compressor plant is supplied from the suction blowoff, with the discharge supply serving as standby for the plant. When it is necessary to blow down a section of the pipe line, one of the spool pieces is bled down, unbolted from the blowoff and fuel gas valve. The blowoff is opened. Meanwhile, the plant is supplied with fuel gas from the blowoff not being used.

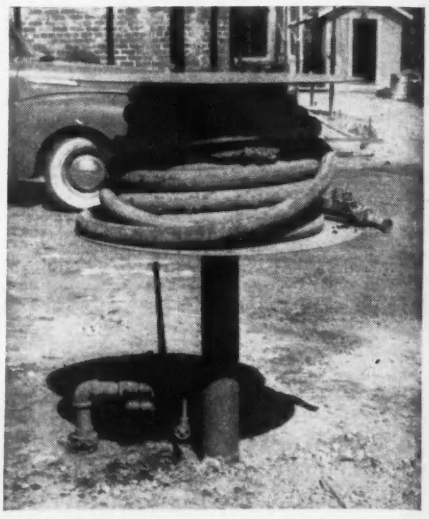
HOW TO—

## Fabricate Efficient Reel for Fire Hose

A reel which speeds hose unspooling and application of water to fires can be inexpensively fabricated using one swivel joint, a quick opening valve and scrap pipe and plate.

The reel is made of two light circular steel plates welded to a short length of pipe sized to fit snuggly over the pipe riser which supports the reel as shown. A packed swivel joint is mounted atop the supporting riser, which extends about six inches from the upper side of the reel. A short length of pipe attached to the swivel extends through a hole in the barrel of the reel. The standing end of the hose is attached to this pipe.

Flow through the hose is controlled by a quick-opening valve at the base of the stand. A long handle on the valve permits the operator to kick the valve open as he grasps the hose nozzle.



By the time the hose is unreeled, water or fog spray will be coming through the nozzle.

The large diameter flange on top of the reel protects the hose from direct rays of the sun during the hottest part of the day.

A sleeve welded to the stand serves as a bearing and support for the reel.

HOW TO—

## Insure Bond Between Primer and Coating

An ordinary turkey feather duster was used by a contractor to brush dust off the cleaned and primed pipe just ahead of the coating and wrapping machine to insure a better bond between coating and primer.

During dry summer months when construction machinery stirs clouds of dust, care must be taken to remove the dust and dirt that settles on the pipe between the time it is cleaned and primed and the time it is coated.

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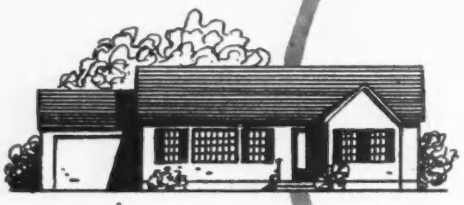

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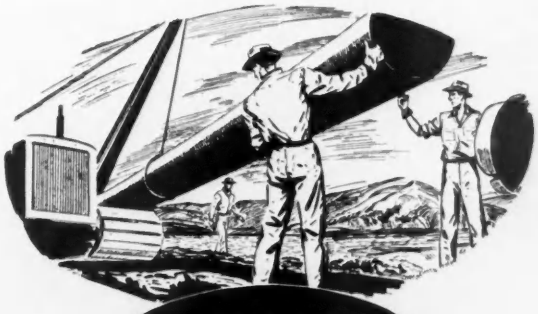

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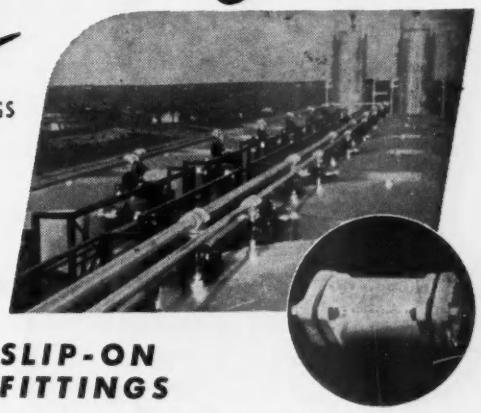

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## HOW TO—
# Build Inexpensive Valve Platforms

Money was saved in constructing four valve platforms by using a demountable design which could be shop fabricated and setting the platforms on footings previously poured with guides to receive the legs.

The platform was constructed in the shop from 1½-inch pipe as shown. It was framed with three-inch channel iron and covered with expanded metal grating. Rungs of the ladder were cut from extra heavy one-inch pipe.

Jigs were set up in the welding shop to speed fabrication. After the platforms were completed and painted they were slipped over the pipe-stub guides in the concrete footings.

The footings, which had been poured previously, each have a stub of one-inch pipe which slips inside the 1½-inch pipe forming the legs of the platform. These footings were completely cured and finished before the platforms were set in place.

To remove the platform for maintenance purposes, it is simply lifted off the pipe stubs.

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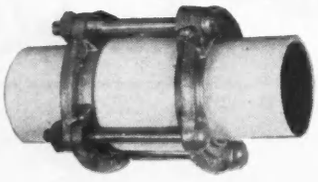
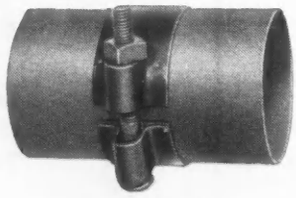
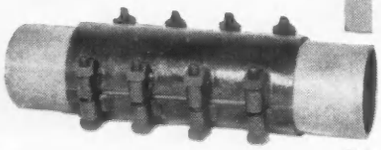


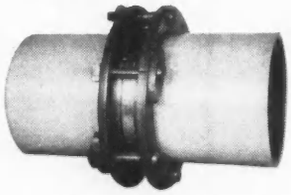
COLLAR CLAMP
Styles 4 and 41, for repairing and preventing leaks through threads of screw collars.



BAND CLAMP
Style 77B, for repairing small leaks and holes in the run of pipe.



SPLIT REPAIR CLAMP
Style 79B, for repairing pitholes and longitudinal splits in pipe.



POROUS-WELD CLAMP
Style 55, for repairing circumferential weld leaks.

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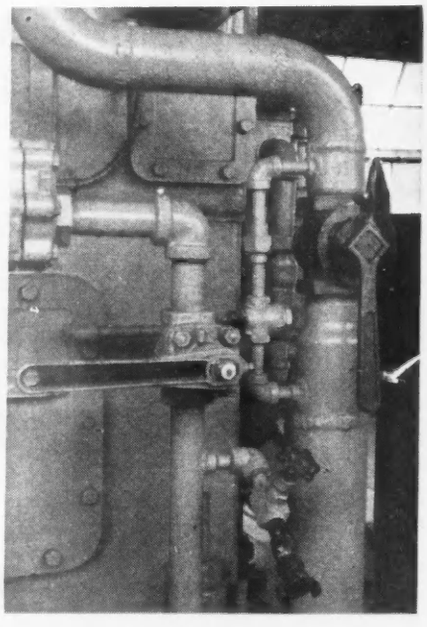
## HOW TO—
# Regulate Fuel Gas For Engine Startup

A bypass around a compressor engine fuel gas valve makes engine starting safer and improves fuel regula-



tion when the engine is running under load.

The fuel gas supply lines for compressor engines are commonly fitted with sizeable valves that easily accommodate the maximum fuel flow needed when the engines run a full operating load.

During startup operation of the engines this fuel gas flow would be excessive, and it is necessary to "crack" the fuel valve just sufficiently to allow the right small volume of gas to flow. This is a difficult adjustment with a large plug valve. One company avoids the usual difficulty, the "tinkering" with the large valve, by means of small bypass valves installed around each main fuel valve. The small valve, opened wide, supplies just the right amount of gas for start-up operation.

## HOW TO—
## Make Improved Sling For Handling Drums

A short chain sling with chimes attached to the two ends simplifies handling drums of chemicals at the water treating building of a compressor plant.

Two cold shuts were attached to a heavy metal ring as shown. The two lengths of chain were welded to chimes fabricated from half-inch steel plate, sized to fit over the end of the drum hoop.

Use of the sling enables a workman to handle the drums with speed and safety.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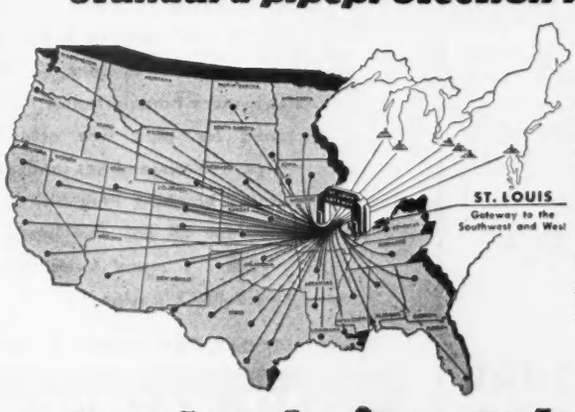


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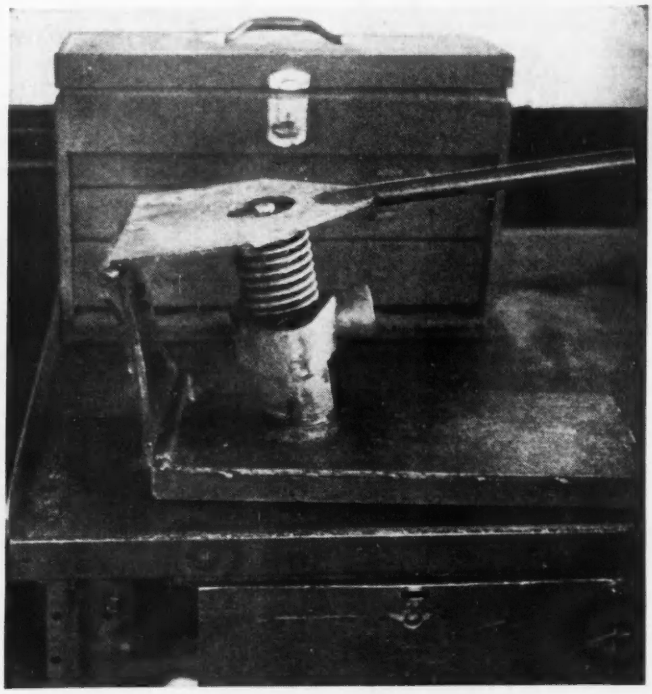
# HOW TO—Compress Valve Springs



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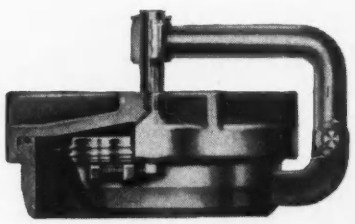
A hole in the upper plate provides a guide for the valve when the spring is compressed.

The only 2-PIECE blanking plug unions



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# International Section

DON KLIEWER, SECTION EDITOR

WORLD OIL


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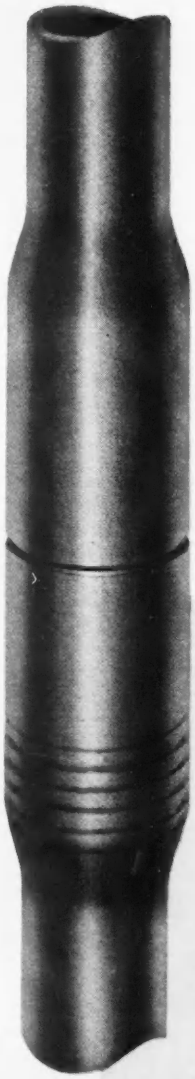
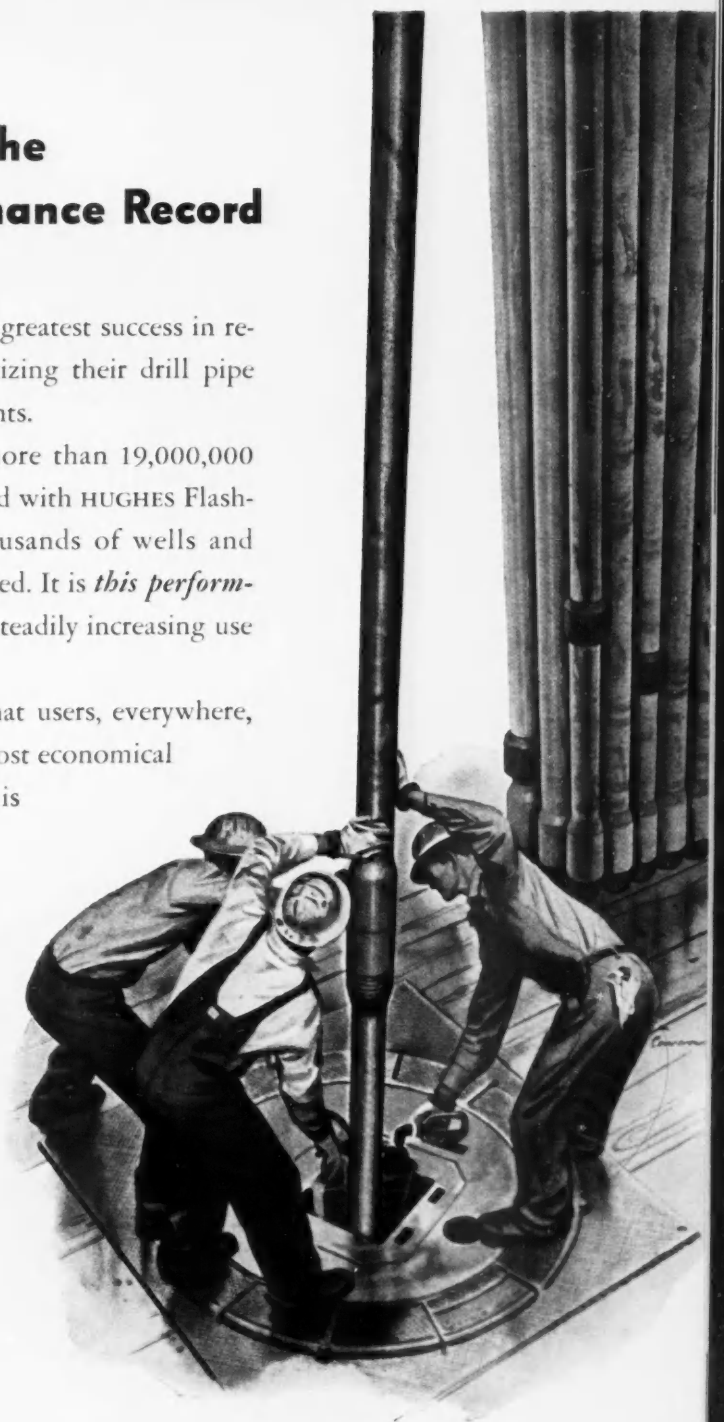
It also accounts for the fact that users, everywhere, will tell you that the strongest...most economical ...and safest tool joint you can buy is HUGHES Flash-Weld.





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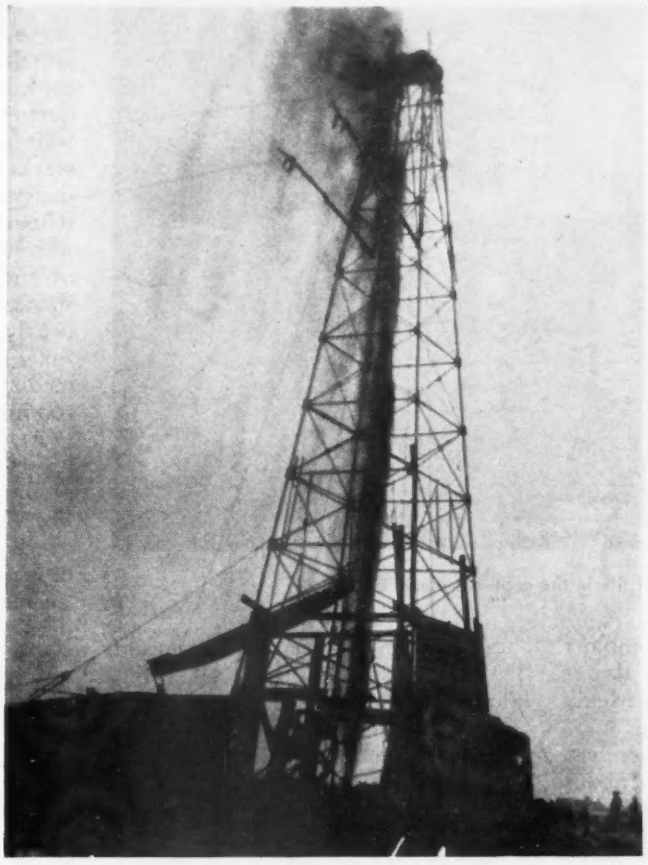
COMPLETE DRILLING MUD SERVICE

# KINGDOMS OF OIL

*No. 8*

By DON KLIEWER
WORLD OIL Staff



Rogers discovery well as it blew in.

# MEXIA, TEXAS

**THE FIESTA DE MEXIA, which is being held the first week in October, is an annual celebration into which go the energies of practically all residents of this progressive Texas town. The throngs who will join in the Fiesta will be reminiscent of the street-filled scenes of the early 1920's, when an avalanche of excited humanity descended upon the town after the Rogers discovery well was brought in November 19, 1920. Mexia survived the tempestuous era of wild leasing and gushing wells, wealth and near wealth, to become the solid, progressive community Fiesta visitors will find today.**

SOME wells are drilled on an anticline and some on a syncline, but the well that led to the discovery of the Mexia field was drilled on an overdraft.

On November 19, 1920, the Rogers discovery well came in a producer to justify the faith of Mexia that somewhere nearby oil reservoirs were waiting to be tapped. But the history of the Mexia boom goes back further —to 1912—when Blake Smith, Sr., a banker, organized a company of 100 businessmen who agreed to ante up $1000 each to drill ten wells in an effort to find natural gas with which to alleviate the growing fuel need.

This company, the Mexia Oil and Gas Company, drilled nine straight dry holes. Some sponsors dropped by the wayside, but Smith, doggedly fighting to keep the organization intact until gas was found, kept those individuals on the company rolls, and he talked the drilling contractor into drilling two wells in place of the tenth.

The tenth was a failure, but the 11th was successfully completed as a dry gasser, affording Mexia a sufficient fuel supply with enough left over for Corsicana, Teague, Waco, and other towns in the area.

And it was with the gasser's completion that Smith was able to clear an overdraft of $4800 on which the company had been operating for several days prior to the discovery.

Later, the faith of Mexia Oil stockholders was again put to a test. With the gas field exhausting, they believed their wells were over or near an oil pool. F. Julius Fohs, then associated

Mud was a part of life in the good old Mexia boom days.

with the Humphreys Oil Company and others, joined with W. A. Reiter in accepting an interest in Mexia Oil's lease block to drill a well.

The well was begun in September, 1919, on the L. W. Rogers farm, about three miles west of Mexia, but the test was fraught with difficulties—the first hole was lost, the derrick was skidded, and delays compounded on the second well. With expenses soaring far beyond the original estimate, John A. Shephard of Muskogee, Okla., who agreed to drill the well, offered a half interest to the highest bidder.

Colonel Albert E. Humphreys, of the Humphreys Oil Company, bought Shephard's interest, and drilling was continued. While Humphreys and Fohs were no newcomers in the oil business, some of their acquaintances viewed the Rogers well with pessimism.

But Humphreys and Fohs were steadfast, and on November 19, 1920, the gamble paid off. The Rogers well came in with a 50-barrel daily yield. Though not large, the well stimulated more extensive operations at Mexia and the field quickly carved for itself a niche in Texas oil history.

Immediately afterward, Mexia became a magnet for hordes of transient oil investors, speculators, jobless, and bums; it was a beehive of activity, quick action and high stakes. Autos of all descriptions lined the curbs of unpaved streets while horses fought the black mud in front of wagons creaking beneath tons of oil field supplies. Millionaires brushed shoulders with outcasts; ringleted school girls, modishly gowned women, and their more modestly clothed sisters stemmed the tide of street traffic, jostling and rubbing elbows with the greasy, grimy workers of the oil field. Many of the townfolk, during the while, sunned themselves in convenient seats or stood on street corners, dazed by the sudden influx of humanity thrown up on the streets of Mexia by the crest of the mounting oil tide.

All facilities were swamped. Jumping in a month from 4000 to 40,000 population, Mexia couldn't meet the growing needs. Blocks-long lines queued up before cafes. Some had to wait hours for their meals. New stocks were depleted from store shelves minutes after arrival by prairie schooner. Oftentimes, new supplies were sold directly from the caravans of incoming wagons. "Shotgun" shacks appeared as if by magic in nearly every available space. The shacks dotted the school yard and immediately became overtaxed classrooms.

At least one supply company got its start by taking orders on a table in the rear of a Mexia banana shop. Post office general delivery boxes were overflowing. Many persons grew tired of waiting from around 3 a.m. to noon for mail, and changed their postal addresses to Wortham, Groesbeck or other surrounding towns, preferring to ride four or five hours by horse or wagon than to stand in line twice that long.

Burdened by the bedlam which reigned outside and the mountainous stacks of mail inside, Postmaster B. W. Simmons, the first white child born in Mexia, made every effort to obtain a replacement for himself. He wanted to enter the leasing business, but his attempts to quit were futile until after the main part of the leasing flurry had passed.

His daughter, Miss Nanine Simmons of J. K. Hughes Oil Company, Mexia, recalls her father saying he was "so busy working that he didn't have time to answer the knock of opportunity."

Finally, Simmons wired the president of the U. S. in 1921: "When I lock up Saturday, I'm going to throw keys away." His replacement was dispatched without delay, but too late for Simmons and his leasing aspirations.

Booming Mexia greets 350 Corsicana visitors who toured the new field.

The wheels of destiny upon which Mexia was riding turned so fast and lost their sense of direction to such an extent that Governor Pat M. Neff had no recourse but to declare Mexia under martial law in January, 1922. Rangers soon subdued the tumult.

All the while sensational well completions were continuing. On August 29, 1921, Western Oil Corporation's Desenberg 1, two miles northwest of Mexia, gushed oil over the top of the 112-foot derrick. Drilled to 3059 feet, the well yielded 18,000 to 25,000 barrels a day. Later the same day, Adamson 1, on W. L. Adamson's farm a half mile from Mexia, was completed as the largest producer in the field with its 1000 barrels an hour. Such wells as these enabled the field to produce 176,000 barrels of oil a day at its peak.

Mexia's boom was not without stories of quickly-won wealth and the millions that fell just out of reach. One Negro land owner on whose farm gushers brought hundreds of thousands of dollars drove into town in a bright, new car and ordered seven pianos.

"Why do you want seven pianos?" the puzzled storekeeper asked.

"Got seven daughters!" came the succinct reply.

Then there is the J. K. Hughes Oil Company which in one boom year paid four 100 percent dividends.

One man, whose relatives live in Mexia today, owned a farm some distance from the initial discoveries. During the lease-crazy days of the boom, he was offered $1000 an acre for his farm of several hundred acres.

With an eye toward even greater wealth, he refused. The field, 20 miles long, came right up to the fence on the south side of his farm—and stopped.

### A Woman's Way

J. K. Hughes, who went to Mexia to get into the oil play, stayed on to become the "Monarch of Mexia."

The Mexia of today is modern, progressive.

Hughes parlayed $6000 worth of his wife's jewels into millions. He organized so many companies that Miss Ilene Westmoreland, his secretary, used many of the corporate seals for door stops. Today, Miss Westmoreland recalls with a smile, the dignified hunt that began in Hughes' headquarters each time one of the seals was required in the processing of papers.

Of Hughes' many companies, some were named for the number of men participating—44 Royalty Company, 25 Royalty Company, 18 Petroleum Company. Others were the Never-Such Oil Company, and Heart of Pool Royalty Company.

One day, Hughes' wife asked why women couldn't organize and operate an oil company. A dynamic personality who helped write much of Mexia oil history, she pondered her own question for a while, and then acted. The Why Not Oil Company, composed entirely of women, was the result. The company had production and one of the best leases in the Wortham field.

Early in his Mexia career, armed with the $6000 from his wife's gems, Hughes obtained a lease from E. L. Smith. He went out to it, and looked long and hard. What happened afterward is a matter of recorded history, perpetuated in the files of The Mexia *Daily News*.

"I was a pretty fair creek geologist," Hughes later told a reporter, "so I geologized my lease myself. I went out to a creek west of town and told them: 'That field's goin' right up this creek'."

The "creek geologist" was right. His first well, the Ellis 1, came in for 6500 barrels a day.

When the "Monarch" died in 1942, there wasn't a church, a charity or a philanthropy in Mexia which had not felt his touch at one time or another.

The wealthy and poor, happy and sad days of the past live on in Mexia now only over the coffee cup or in the pictures hanging in offices about the town. The tumult has subsided; in its stead is a serene township, entirely without envy of its previous golden era. In fact, there are few in Mexia who have time to reflect at length on the oil boom days because they are too busy.

The people, says E. C. Deane, editor of *The News*, "have achieved the effect of another boom—a solid, quiet boom that is here to stay."

Minus the gold trappings that brand an oil boom town, Mexia is proud of its general progress. Although Mexia and the surrounding communities are making money products from tapioca to tanning and from potatoes to plastics, one of Mexia's best-known landmarks is the gigantic oil storage tanks which are currently playing a dominant role in Mexia's post-oil boom economic development. Two grain storage companies, Cargill, Inc., of Minneapolis and the Harvest Queen Company of Texas, took over the tanks and converted them into storage bins. As a result, Mexia has grown into one of the nation's largest grain storage areas.

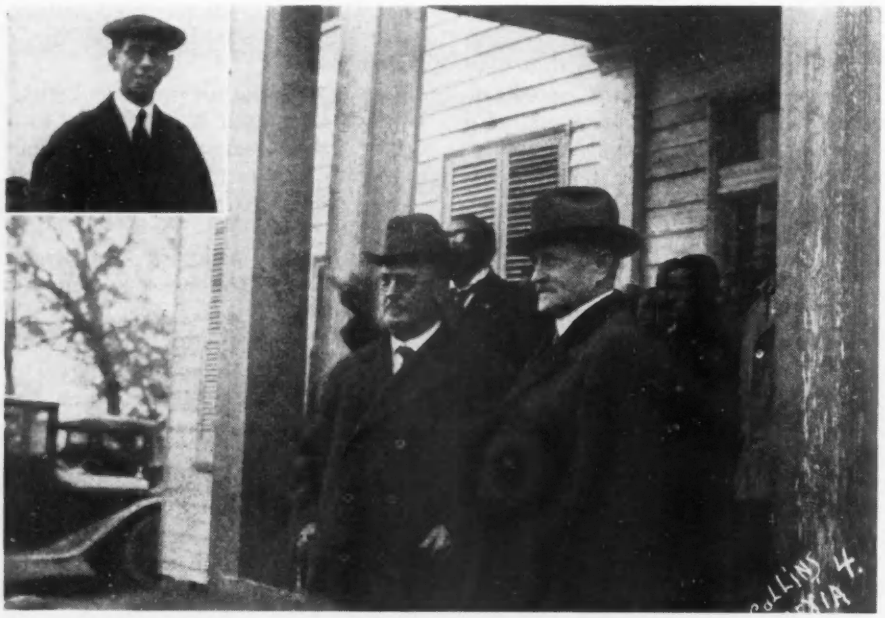
Leased from the Stanolind Oil & Gas Company, the tanks are two

An air view of the field in the early 1920's.

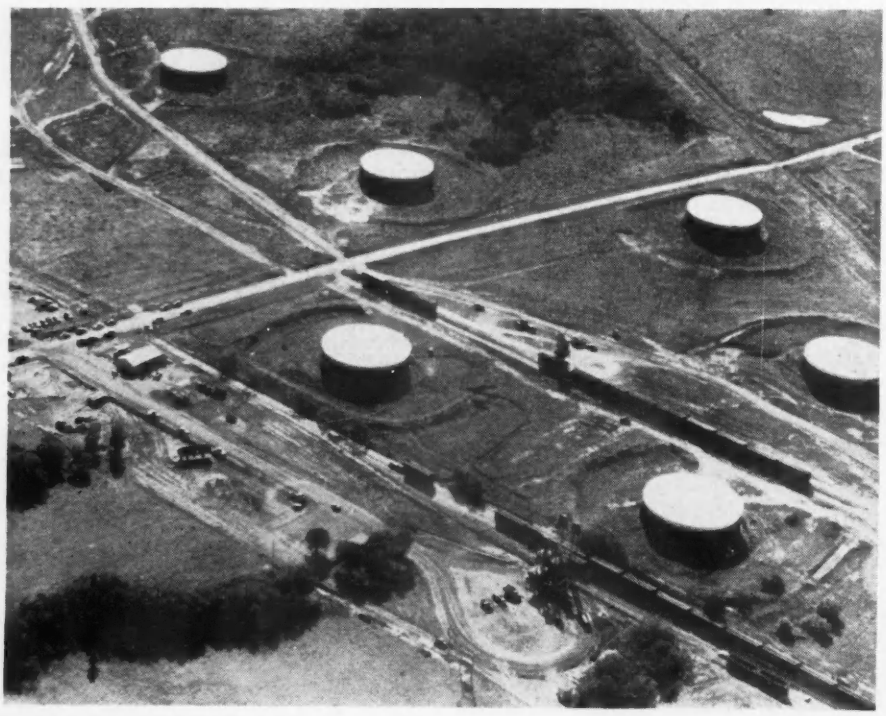
sizes, one holding 370,000 bushels and the other 200,000. Cargill has 38 tanks under lease with a total capacity of 9 million bushels of grain. Recently 4.5 million bushels of maize were in storage, and Clarence Swan, Cargill superintendent, and Curtis Chrisner, Cargill foreman, said their company, which began operating in Mexia on September 10, 1949, is beginning to store wheat.

Living conditions in Mexia are on a parity with those of cities of much greater population, and yet are without many of the disadvantages which exist in some of the densely-populated areas. Friendly and progressive, the community has made exceptional forward strides in religion and education.

When the 1951 school term began, three of the four school buildings were not more than two years old. Mexia's old City Hall and fire station are scheduled to undergo remodeling and will house the local National Guard unit. A new fire station costing $15,000 has been built and paid for with money from the sale of the former station. The courthouse was built in 1928 for $150,000, a fraction of its current value.



F. Julius Fohs (inset), Colonel A. E. Humphreys and Gen. John J. Pershing.



Huge oil tanks of yesteryear are grain bins of today.

Filling a long-standing need, the new Gibbs Memorial Library, a $175,000 gift from Mr. and Mrs. Jesse Jones of Houston honoring her parents who were early Mexia settlers, offers the city one of the best-equipped smaller libraries in the state.

Twenty-seven churches have been erected in Mexia. Numerous civic, fraternal and service clubs are active. Seven miles south of town is Fort Parker State Park on the Navasota River, one of the Southwest's finest. It is the site of an early-day Indian massacre.

Mexia's community spirit is expressed annually by the Fiesta de Mexia, a week-long event held in October. Sponsored by the Mexia Junior Chamber of Commerce, practically everyone in town participates. Public schools hold a "homecoming," and many former residents return. The Parent-Teachers Association and the Band Parents Club stage a street carnival. Jaycees set up farm equipment displays and exhibit farm produce and women's handiwork.

Mexia's growth is still surging forward. One contractor expressed the belief that more building activity is under way in Mexia now than during any period since the oil boom. This building boom has accounted for approximately $268,750 worth of construction projects in the over $500 class during the first half of 1951, city records reveal. This figure is only approximate, says City Manager Howard Mace, and possibly could be greater when year-end results are tabulated.

Noel Hollingsworth of the First National Bank of Mexia said his bank has "made perhaps more home and business improvements loans this year than at any other time in the history of this Bank".

City records reflect only construction within the city and do not include the quarter of a million dollar expansion of the textile mills or the $668,000 project at the Mexia State School and Home.

And that is Mexia—past and present. In the minds of those in whose hands lies the future of Mexia is a "hunch" that perhaps oil from a deeper horizon will play a role in their city's future. The hunch is so strong that it is difficult today to obtain mineral rights.

"Deep oil out yonder?" muses Elgin (Red) Means, Majestic Hotel porter since 1924. "Mebbe so, mebbe not, but lots of people hereabouts do think so. Testing wells are goin' on all the time. Mebbe one of these days . . ."

Maybe.

# It takes BOTH curves to get the full story

The Gamma Ray does a great job in charting the formations pierced by the well, there's no denying that. But the Gamma Ray curve is something like the first half of a book — it doesn't tell the whole story. For that, for the last chapters of the book, you need the Neutron curve.

Since the Neutron instrument responds to formation fluids, it supplements and completes the story started by the Gamma Ray (which does *not* show fluid content). As an example, take the not unusual case of a productive sand or limestone formation with impermeable streaks which, in effect, form separate reservoirs. The Gamma Ray curve defines the extent of the whole body, but it takes the Neutron curve to show the location and extent of the impermeable streaks and thus indicate the best possible completion program. The Neutron curve also makes unmistakably clear the difference between certain formations which sometimes record similarly on the Gamma Ray curve.

As if this were not enough, the Neutron curve supplies still further information. Being sensitive both to fluid and to the shielding effects of casing, the Neutron curve is of great value in establishing, accurately, the location of casing seats, liner overlaps and the well's fluid level. So, on your next well logging job, give thought to getting *both* curves — having the complete story pays.

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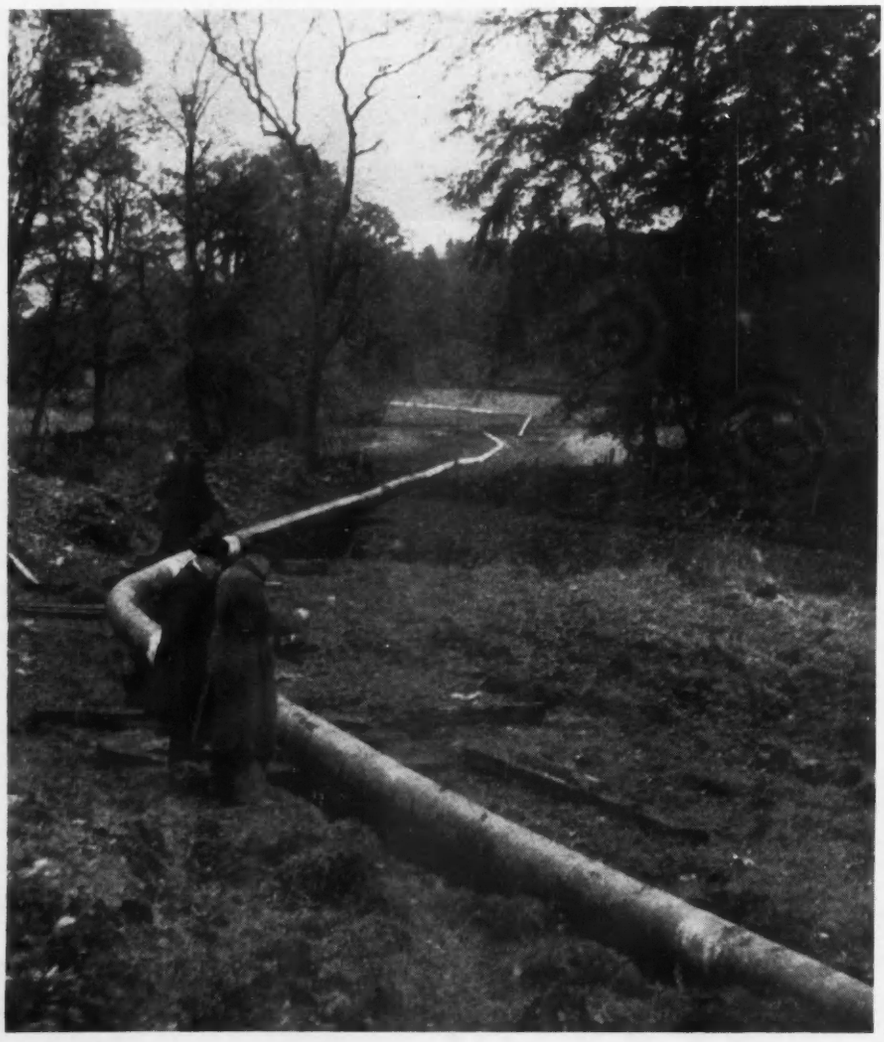
Every possible attempt was made to avoid fertile land, but on this span there was no alternative but to sweep straight across the meadow.

# From Grangemouth to the Sea

To avoid fertile agricultural areas, the pipe line wends through this marginal land.



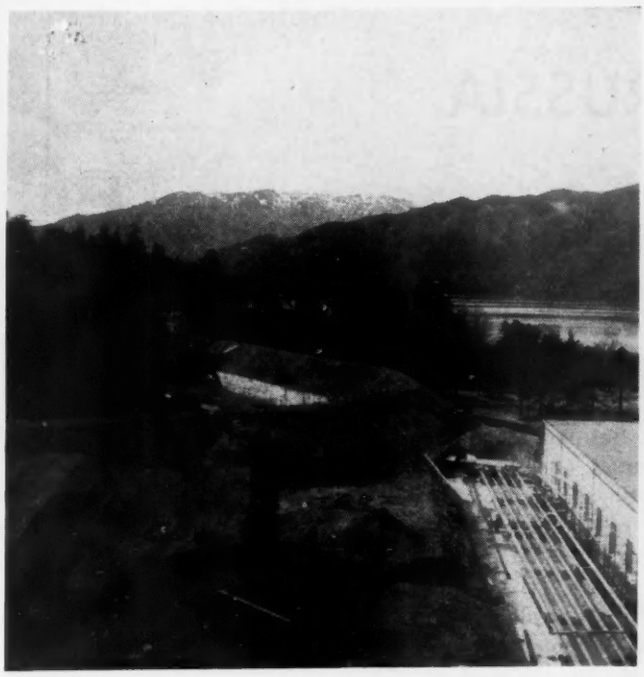
THE Finnart depot, built to meet the needs of Anglo-Iranian Oil Company's Grangemouth refinery for additional dock facilities, and the 60-mile, 12-inch pipe line connecting the depot with Grangemouth are now in operation, handling a pipe line throughput of approximately 37,700 barrels a day.

The depot's four oil tanks, each with a capacity of about 150,000 barrels, are the largest in Great Britain. In addition, there are two steam-heated tanks with a capacity of 75,000 barrels each for furnace and diesel oil. For maximum fire protection, the tanks have floating roofs.

Finnart jetty was selected because of its deep water immediately off shore, its good waterway from the Clyde, and because the site offered a shorter sea route from the Middle East. These facilities also fulfill berthing requirements of the 28,000-ton tankers ordered by the British Tanker Company.

All-welded steel pipe was used in order to obtain a design based on a maximum high pressure of 800 pounds per square inch. The entire line is protected from corrosion by a coating of asphalt mixed with slate dust and cathodically by use of buried magnesium anodes. The pipe line was shop wrapped with the asphalt mastic because no field wrapping machines were available in Britain. Connections were made for a booster station at the

In the foreground is the floating roof of one of the 150,000-barrel tanks, largest in Britain.

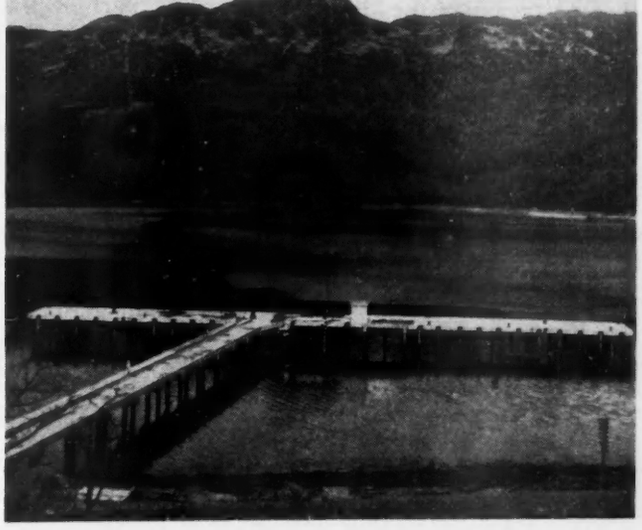


Firewalls are turfed "for aesthetic reasons." Reinforced concrete retaining walls, up to 17 feet high, were built since the confining nature of the site precluded the use of natural slopes.

half-way point if the throughput is increased.

Construction of the depot and pipe line, part of a $52 million expansion planned by Anglo-Iranian in Scotland, was carried out under difficult weather conditions — during one month, rainfall measured 11.8 inches —which adds to the credit of the personnel for the speed with which the projects, begun in 1950, were completed.

Unloading facilities at Jetty Loch Long offer deep water very close offshore.



The Norwegian "Tank Empress" is on her way to the Finnart jetty with the initial cargo of oil for the depot.

*A look behind the Iron Curtain*

# OIL IN RUSSIA

## *Part 1*

By DR. LEONID SMIRNOV

**SINCE RUSSIA has laced together most avenues of information, democratic countries have been faced with a dearth of information with which to piece together a picture of that part of the world's petroleum industry and geology which lies behind the Iron Curtain, deep within the heart of Russia itself and within the boundaries etched in communistic red. WORLD OIL, in an effort to shed all possible light on so dim a subject, presents the first of a series of articles prepared by Dr. Leonid Smirnov, international authority on Russian petroleum geology.**

IN RECENT years, no Soviet Union oil industry development information has been available to foreign countries because the Soviet government, which considers oil as strategic raw material, wants to keep secret its war preparedness and the accumulation of military oil reserves.

In a review of the USSR oil situation in the July 1948 Atlas issue of WORLD OIL, an exhaustive picture was given of the development of the oil industry of the USSR. Nothing essential can be added to that review, except for a few elucidations. Very properly, the review pointed out the striking disparity between the growth of prepared reserves and output in the Soviet Union and the U. S. The lagging-behind of the former, in spite of the high degree of geological oil science and science of oil refining, is directly traceable to lack of equipment for drilling and production as well as for refining. This lack of equipment, in turn, is solely the result of the specific conditions of the Soviet economic system which are utterly inefficient, unproductive and unwieldy.

A distinctive feature of the Soviet economy throughout the existence of the Soviet regime has been the perennial scarcity of everything, from industrial equipment to food and other consumer goods. The Soviet economy, isolated as it is from the rest of the world, has never been able to overcome this specific and unmatched crisis.

WORLD OIL's review also correctly pointed out that all damages inflicted during the Nazi invasion to the Maikop and Grozny areas in Northern Caucasus have been fully repaired.

The war and postwar years mark a specially rapid growth of the oil production in the regions of the so-called "Second Baku," that is, the area beyond the Volga and the Urals, which at the present time, it may be assumed, supplies no less than 36 percent of the entire Soviet oil output. In this Second Baku the Devonian oil deposits have proved of particular importance. In the near future, this Second Baku area most probably will witness a much greater development and its production will show a steady growth until its percentage compares favorably with that of the Caucasus. This phenomenal growth of Second Baku is wholly due to its strategic value and its favorable location far removed from the western Soviet borders towards the interior.

Special attention at the present time is likewise given to oil development on Sakhalin Island and the moving of that oil to the mainland and refineries in the Far East, for the reason that, thus far, Sakhalin is the only region in Siberia capable of increasing greatly the oil output within a short time. Sakhalin has great strategic importance and at present is the only region that supplies directly the Soviet armed forces in the Far East.

Much attention also is now given to the solution of the problem of oil bearing of Kamtchatka, since its oil would supplement the reserves of the Far East armed forces. Shipment of oil to the Far East from either Second Baku or the Orsk plants of Southern Ural, which process the Emba and Baku crude oil, is limited to the carrying ability of the trans-Siberian railroad, fully occupied with transporting all strategic cargoes. This scarcity of oil products in the Far East, coupled with this difficulty of shipping them from European Russia, acts as a brake upon Russia's ability to carry on wars in that distant theatre.

WORLD OIL's review very properly emphasized the wide development of research work of all kinds in exploration and discovery of new oil sources. In the course of the last 20 years a number of large and hitherto unknown oil fields have been discovered, which by now have in part entered the operation stage. At the same time, old fields known from pre-revolutionary times have been substantially widened. In these latter areas numerous new structures have been uncovered, and even new fields now are in full exploitation.

Many prominent American oil geologists and economists are absolutely right in their opinion regarding the presence of large oil reserves on the territory of the Soviet Union. Their appraisal of the oil facilities in the USSR fully agrees with that of Russian geologists. Both groups estimate the proved oil reserves to be on the order of a billion tons, or between 7 and 8 billion barrels, while the potential oil reserves of the Soviet Union, estimated on the basis of geological data, according to official Soviet statements, before the war years reached 60 billion barrels. Today's possible oil reserves, calculated on basis of geological data, have increased considerably, inasmuch as the prewar estimates of reserves did not include the reserves of the Ukrainian salt dome basin, the Taimyr oil-bearing basin in the Siberian Arctic, the Siberian basins of western and eastern Siberia, and Kamtchatka.

Under the postwar Five-Year Plans the oil output by 1960 is to reach

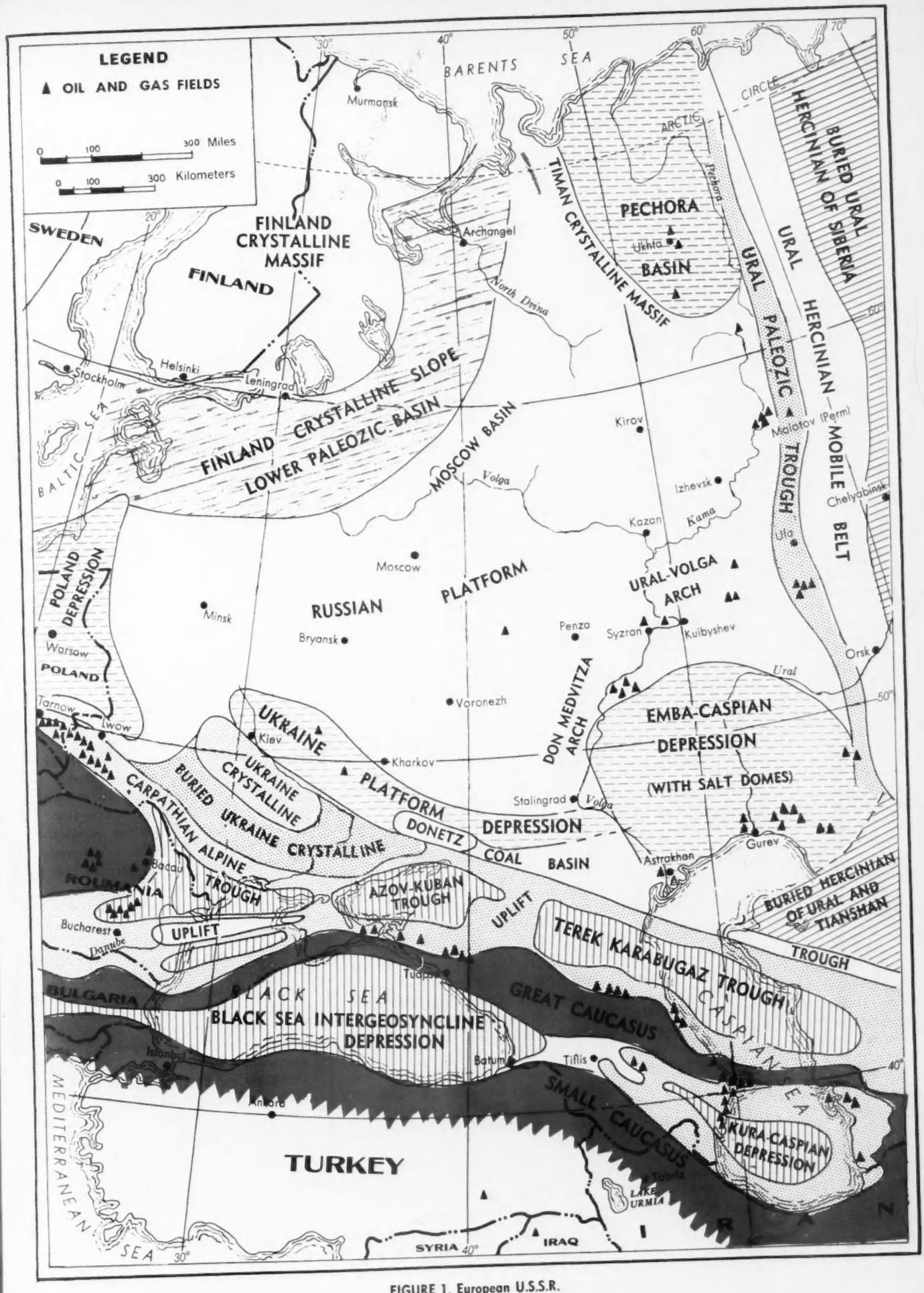



FIGURE 1. European U.S.S.R.

420-450 million barrels a year. Special orders of the Ministry of Oil Production provide for a production increase of 25 percent a year. Official data on 1950 output mean the equivalent of 38.6 million tons, or 270 million barrels. There is, however, reason to believe that that figure is an understatement, dictated by political considerations, and that the actual figure is more probably 42 to 45 million tons (about 300 million barrels).

Reserves of 7 or 8 billion barrels in known structures should enable the Soviet Union to increase its oil output rapidly. However, such rapid increase is limited by conditions of the Soviet economy, with its constant lack or scarcity of drilling and refining equipment and pipe lines. The Soviet communist system, isolating itself from the outside world, fearing any such contact because of possible "contamination" of its enslaved people by "bourgeois foreigners," and guided not by national interests but rather by international policies aiming at subjugating the whole world, is unable to provide by its own strength all that is needed for the oil industry. The USSR thereby throttles the development of its oil industry as well as its entire national economy.

The weak point of the review in WORLD OIL is the absence of authentic latest detailed data on the Soviet oil output. This makes it advisable to also include a brief geological review of the oil-bearing basins of the Soviet Union, to supplement the meager information on Soviet oil, if not actually supplant it, with a true picture on the natural oil resources, which would also indicate any further prospects for the future development of the oil industry.

This geological analysis of oil-bearing basins of the USSR is based on the maps and charts in the July, 1948, issue of WORLD OIL, with slight corrections and additions.

### Geological Structure

The geological structure of the Soviet Union is characterized by two large stable structures called platforms, namely: the East European, or Russian Platform; and the Siberian Platform, whose development goes back to preCambrian times. These vast structures are separated by the Ural mobile belt that has been in existence since preCambrian times and completed its geological development at the end of the Paleozoic time. It is with these two great geological structures, the Russian and Siberian platforms, and the contiguous promontory troughs, that all oil-bearing basins of the Soviet Union are connected.

The Russian Platform (see Figure 1) is bounded on the northwest by the Caledonians of Norway, on the southwest by the alpines of the Carpathian mountains, the Crimea and the Caucasus. On the east it is skirted by the hercinians (or Upper Paleozoic) of the Urals. A major part of the surface of the Russian Platform is covered with a thick series of Paleozoic rocks, in other places with Mesozoic and Tertiary rocks. It represents an immense basin of great interest from an oil-bearing viewpoint. The crystalline rocks of the basement of the platform emerge only in the northwest, forming the Finnish crystalline massif; in the southwest, forming the Ukrainian crystalline massif, and in the northeast, i.e. the Timan, projecting itself in the shape of a narrow strip.

The basin of the Russian Platform, itself, is split into a number of independent basins closely connected with each other. The Moscow basin, situated in the center of the platform, fills out a large syncline and is composed of a thick series of Paleozoic and Mesozoic rocks. The basin of the northwestern slope of the platform lies on the southern slope of the Finnish massif and is composed of Lower Paleozoic rocks. The basin of the Ukrainian depression with its salt structures is between the Ukrainian and Voronezh crystalline massifs and is composed of Paleozoic, Mesozoic and Tertiary rocks. The basin of the Caspian depression with its salt domes is situated in the southeastern portion of the Russian Platform and is composed of Paleozoic, Mesozoic and Tertiary rocks. The basin of the Pechora depression is in the northeast corner of the platform, between Timan and the Urals, and is composed of Paleozoic and Mesozoic rocks.

These separate basins are divided by broad arches, such as the Volga-Ural, the Don-Medvitza, and others, which may also be viewed as independent basins of the Russian Platform.

The basins with already established commercial oil production are:

1. The basin of the Caspian depression—the Emba region of salt domes;
2. The basin of the Ural-Volga wide sloping arch;
3. The basin of the Don-Medvitza arch, skirting the Caspian depression;
4. The basin of the Ukrainian depression with salt structures;
5. The Pechora basin, with commercial oil in its southern part.

Potential oil-bearing basins (whose commercial oil bearing has not yet been established) are the following:

- The basin of the northwestern slope of the Russian Platform (i.e. the Baltic and Leningrad area);
- The basin of the Moscow depression with the Oka-Zna arch;
- The basin of the southwestern slope of the Ukrainian crystalline massif, which approaches the Alpine trough of the Carpathian Mountains.

Into a special category of proved oil-bearing basins one should place the basins of promontory (or cis-geosynclinal) troughs contiguous to the Russian Platform, i.e.: The Ural, Upper-Paleozoic with its Lower-Permian oil-bearing reefs and salt anticlines, and the cis-Alpine, which has the richest oil-bearing regions of the Carpathians, the Crimea and Northern Caucasus, and also the Tertiary basin of the intra-geosynclinal depression of the Caucasus with its largest oil-bearing regions of the Kura Lowlands, the Apsheron Peninsula, Eastern Georgia (Gruzia) and Western Turkmenia.

## About the Author

DR. LEONID SMIRNOV writes with complete authority on the geological prospects for petroleum deposits in the Soviet Union. Born in Petersburg, he was graduated from the Petersburg Institute of Mines in 1925. He first worked at the Petroleum Geological Research Institute of the Soviet Union, and in 1932 was made head departmental geologist of the Urals and Emba section of the institute. From 1933 to 1940 he was chief geologist of a petroleum expedition in the Siberian Arctic and also during part of this time was professor of research for the institute. Dr. Smirnov was made professor of the Institute of Mines in Leningrad in 1941. His field of scientific work has been for the most part a study of the different problems of oil-bearing basins and of the relation of oil formations and evaporites, particularly the problems of asphalts and bitumens. Such studies led to the discovery of oil horizons in the Permian and Devonian in the Ural trough and the Russian platform and discovery of new oil-bearing regions at Taymiir, Franz Joseph Land and in the northwest parts of the Russian platform. He was captured by the Germans in 1943, and since late 1949 has been in the U. S. working as a consultant to Standard Oil Company (N.J.) and Standard-Vacuum Oil Company.

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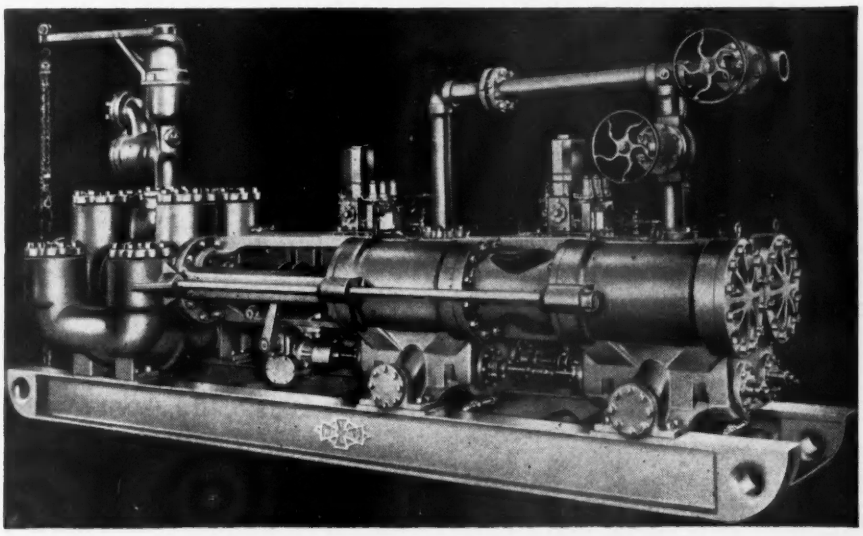

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| Steam cylinders | 16½" and 16½" x 20" |
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| Speed, normal R.P.M. each side | 50 |
| Steam pipe size to each cylinder | 4" |
| Exhaust pipe size from each cylinder | 4" |
| Main cylinder, piston rod diameter | 3¾" |
| Auxiliary cylinder, piston rod diameter | 3¼" |
| Water piston rod diameter | 3⅛" |
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### FLUID END

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| Material, solid one piece steel casting | |
| Hydrostatic tested, discharge ports to | 6000 P.S.I. |
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| Maximum working pressure recommended | 3000 P.S.I. |
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## First Show of Free Oil in Saskatchewan Is Reported

The most favorable show of light oil yet found in Saskatchewan was reported from a well drilled near Tompkins by Socony-Vacuum Exploration Company.

The well, Socony-Vacuum Prairie Tompkins 1, is five miles northeast of Tompkins, which is 50 miles southwest of Swift Current and about 70 miles east of the Alberta border. Although traces of light oil have been found previously in the province, this was the first show of free oil. The well has been virtually ruled out as a possible commercial oil well, but has possibilities of becoming a gas producer.

Gas showings were revealed by a drill-stem test in a sandy limestone structure known as the Hulett formation.

According to the official report, when the test was opened there was an initial flow of 2,071,000 cubic feet of gas per day. Gas appeared at the surface three minutes after the test was opened and the well blew gas and water after 15 minutes. Drilling and testing continued.

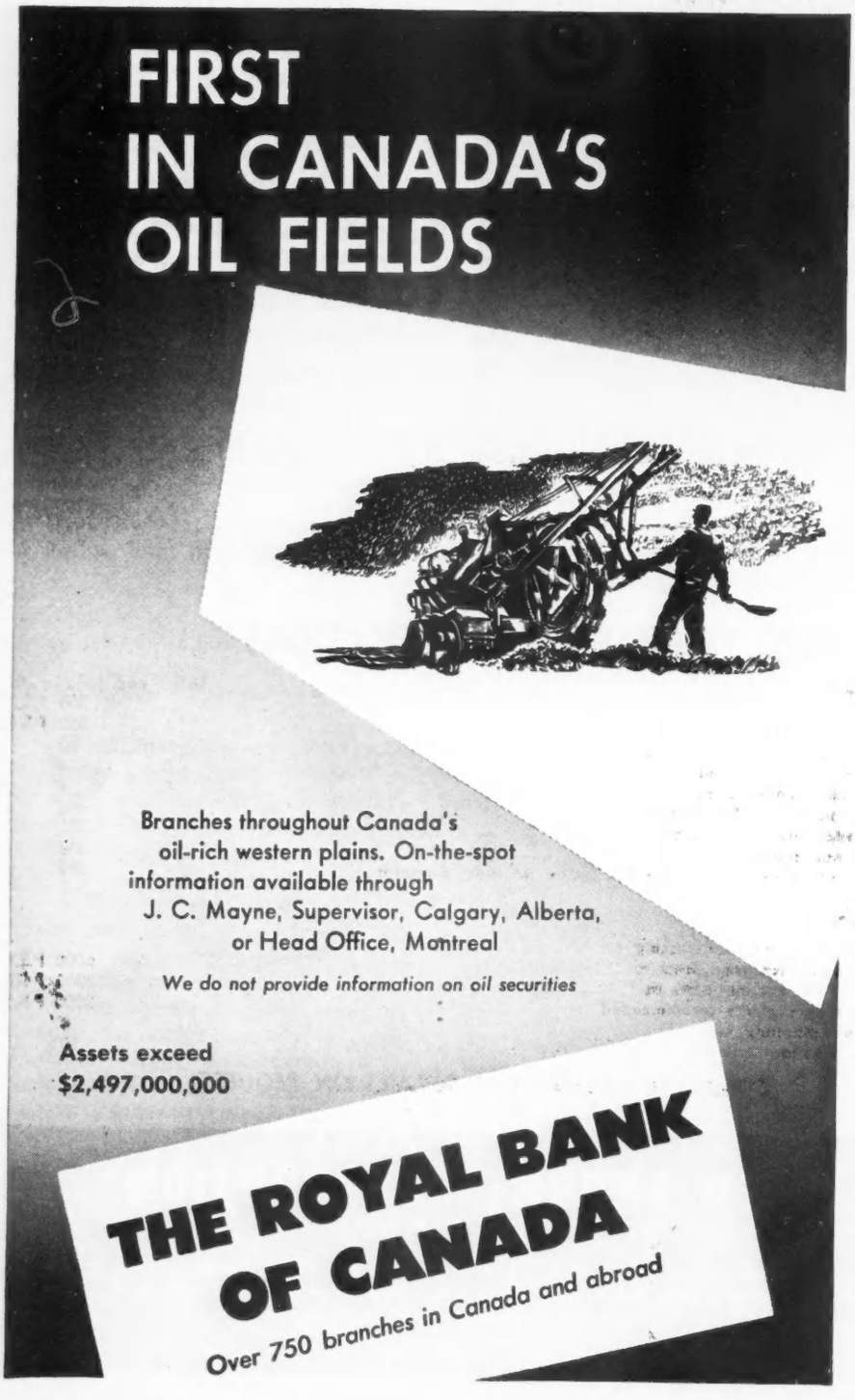
The well was drilled for Socony-Vacuum by Cascade Drilling Company on a farm out from Western Prairie Exploration Company.

Saskatchewan exploratory oil well drilling reached a record high during the first week of July with 12 wells under way, which surpassed the previous record of 11 set in September, 1950.

The number dropped to 11 in the last week of July as two new wells were spudded in and three were completed. However, four additional rigs are on location.

On July 17 Husky Refining Company, drilling contractors, spudded in Bata 26 near Vera, and the next day Lodestar Drilling Company spudded in Husky-Phillips Eatonia A 1, near Eatonia.

Shallow wells completed and abandoned during July included: Sunland Peterson 1 near Peterson, abandoned at 2047 feet; Husky-Phillips Madison 1, abandoned July 20 at 3131 feet; and Albercan Box Elder Creek 1, abandoned July 21.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## General Canadian Price Hike on Gas, Oils Announced

Imperial Oil, Ltd., Canada's leading producing, refining and marketing oil company, announced price increases in gasoline and fuel oils, effective August 1 across the country.

The price boost reflected an increase in railway freight charges authorized by the federal Board of Transport Commissioners earlier in the year.

Edmonton, center of the Alberta oil fields, was not affected by the new price structure since railway freight levies do not influence oil shipped by pipe line to the provincial capital city.

## Albanian Pay Found

The Albanian Government Oil Department has reported the discovery of an oil structure in the Skodra Lake zone. Two wells drilled during the past two months have yielded 80 barrels of oil. Production from each well has been mixed with sand from a depth of 5167 feet.

## Yugoslavian Production

The government of Yugoslavia has reported that its petroleum industry in 1950 met 80 percent of domestic requirements. Officials indicated the output for that year reached 7600 barrels daily. Production of 9000 barrels a day was blueprinted for 1952 in the current five-year plan.

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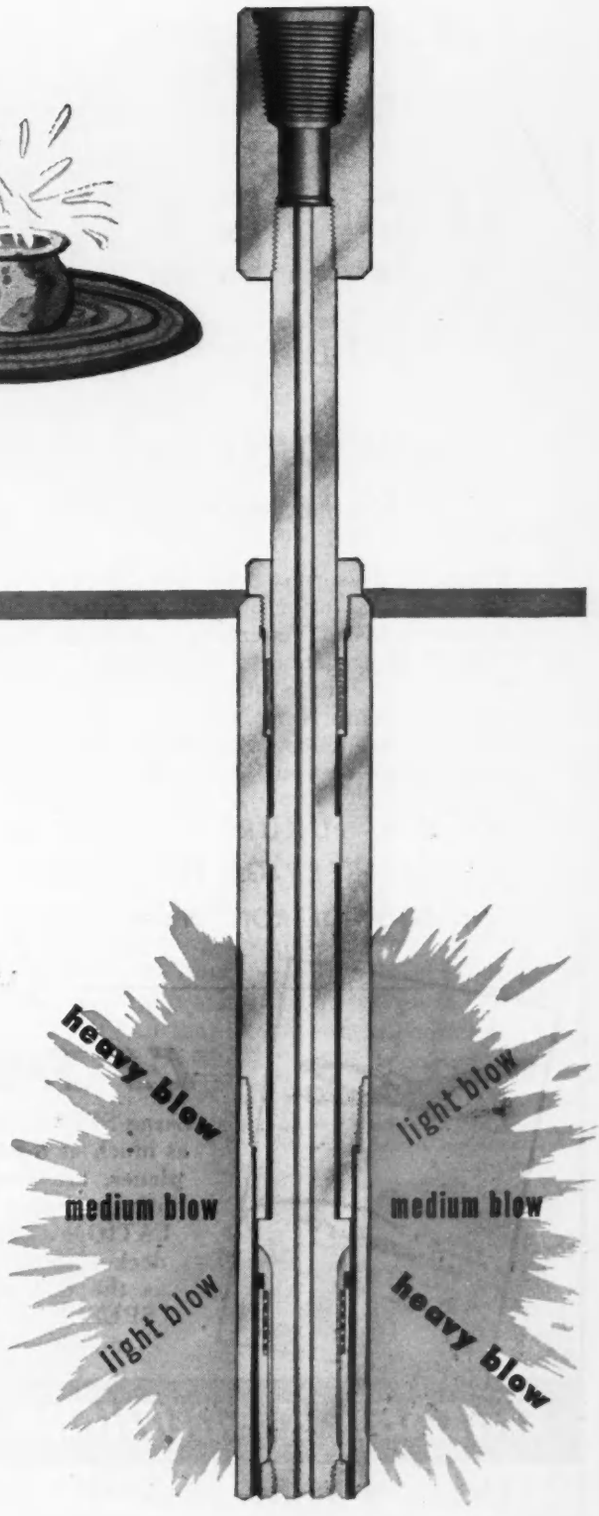


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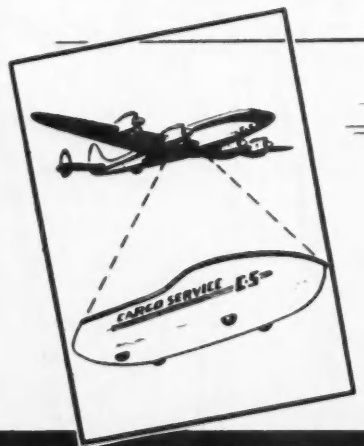


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## Mexican Isthmus Wildcat Being Drilled by CIMA

An exploratory well on the Tecominoacan structure in the Tehuantepec Isthmus area of Mexico has been started, according to Ralph K. Davies, president of American Independent Oil Company. The drilling operations will be carried on by an associated organization, Mexican American Independent Company (CIMA) which recently reported an important oil discovery at Rabon Grande, on the coast near Coatzacoalcos.

Tecominoacan is about 55 miles east and inland from Rabon Grande and is regarded as an area of considerable promise. Seismic survey work has indicated the existence of a structure of large areal extent. The location for CIMA's first test well is in a region where heavy jungle growth and frequent tropical storms impose unusual transportation and operating problems.

CIMA represents the initial American interest to undertake oil development work in Mexico since the 1938 expropriation and is operating under contracts with Petroleos Mexicanos, the Mexican government oil agency.

## Pemex Claims 64 Successful Completions in Six Months

During the first half of 1951, Mexico reported the completion of 148 wells in its five oil-producing sectors. Of this number 56 found oil, 8 discovered gas, and 84 were failures.

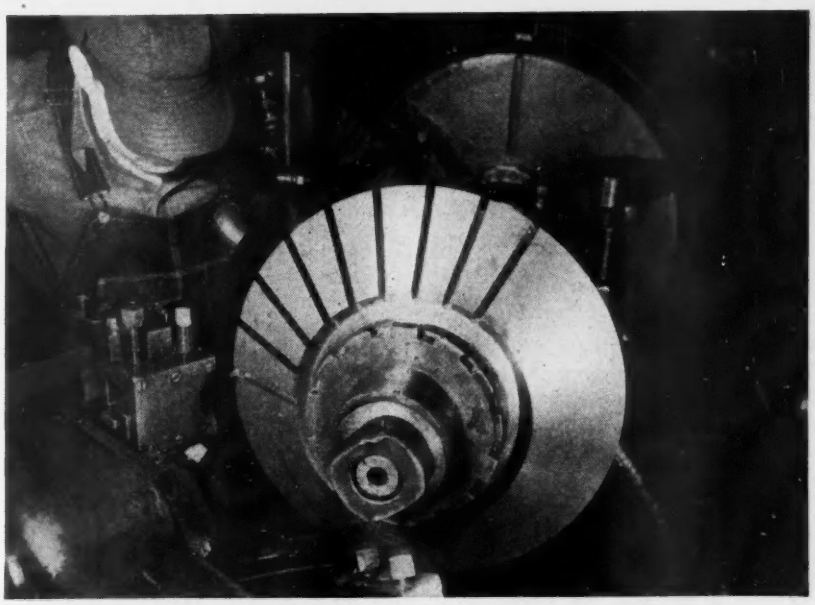
The breakdown showing number of oil wells, gassers, failures, and total number of wells completed follows:

Northeastern Mexico 5, 7, 5, 17; Northern District, 18, 0, 18, 36; Southern District, 12, 1, 45, 58; Poza Rica Area 12, 0, 2, 14; Isthmus 9, 0, 14, 23.

## Creole Output Hits Peak Of 668,184 Barrels Daily

A new peak in production was reached by Creole Petroleum Corporation in 1950, with a daily average for the year of 668,184 barrels, according to the company's annual report. Production in 1949 averaged 591,095 barrels a day.

Net income for the year amounted to $166,930,337, equivalent to $6.45 per share. Dividends to stockholders totaled $87,942,050, or $3.40 per share.



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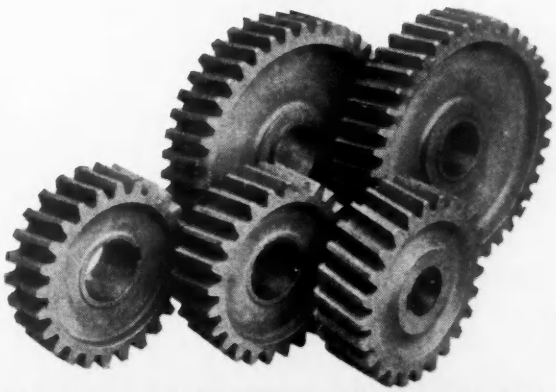

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## Gas, Oil Structures Found In Italy's Bradano Valley

Gas and oil structures have been discovered between Matera, Potenza, and particularly along the Bradano River valley in Italy. The structures run from east to west at depths of 1640-2296 feet for gas, and 4921-7874 for oil. Officials of the hydrocarbons office of the Italian Ministry of Industry said the structures may represent a western extension of the Albanian oil resources.

During the first month of production, two wells, operated by the Azienda Generale Italiana Petroli, 386 barrels of crude mixed with bituminous sands were obtained

Four gas wells drilled in the same zone yielded 5,297,985 cubic feet of methane during the first month of operation. The AGIP has decided to take over the operation of these resources, and has asked the Italian Ministry for Industry for a memorandum showing the advantages of extending to the Bradano River zone the monopolistic regime in oil and gas research work and exploitation established in the Po Valley.

## Poza Rica Is Aiming At 20,000-Barrel Hike

Work has been completed at Poza Rica, Mexico's largest producing oil field, which will increase oil production 20,000 barrels a day and add 200 million barrels to reserves, according to Senator Antonio J. Bermudez, director general of Pemex.

New installations to increase the ultimate recovery of oil by reinjection of gas to the field have been built as part of a $12.5 million expansion of field facilities. Up to 50 million cubic feet of gas per day can be returned to the formation and up to 120 million cubic feet daily can be sent to Mexico City as industrial fuel. Current Mexican production of natural gas is 400 million cubic feet daily, and the natural gas reserves of the republic are estimated at 1.8 trillion cubic feet.

The Poza Rica-Mexico City gas pipe line, built in 1948, is transporting 30 million cubic feet daily, but it can handle the additional gas now available, up to 120 million cubic feet daily.

New Poza Rica field installations include: changes made in the absorption plant at a cost of $2,270,000; sulfur removal and recovery plants yielding 130 tons daily and built at a cost of nearly $2 million; a 12,000-kilowatt power plant costing $2,326,000; a glycol dehydration plant; deisobutanizer unit; pressure maintenance plant; water system; changes in crude stabilizer unit; and a crude pumping station.

Senator Bermudez said the gas pipe line from Monterrey, which will have a branch to serve Saltillo and then be carried west to supply the area around Torreon, will be completed this year. Its 212 miles will cost approximately $8 million.

High on Pemex's future schedule for Mexico's natural gas development is a 405-mile, 20-inch gas pipe line which will also be utilized to take advantage of the abundance of gas in the northeastern fields. The line is scheduled to be started in the third quarter of this year and completed by the summer of 1952 at a cost of about $18 million.

Another project, yet in the planning stage, will supply natural gas for industry in the Isthmus region for the first time. The completion of large gas wells in Xicalango, in Campeche State, during 1950 has led to plans for a gas pipe line from the gas field, near Ciudad del Carmen, to cities in the neighboring State of Yucatan.


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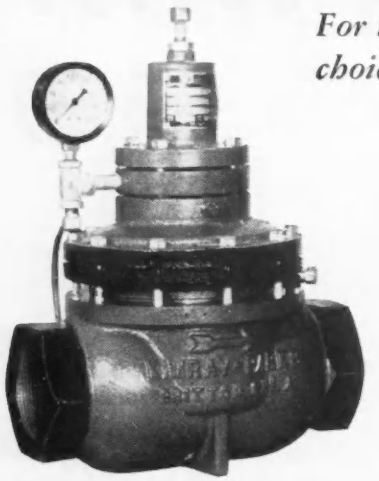

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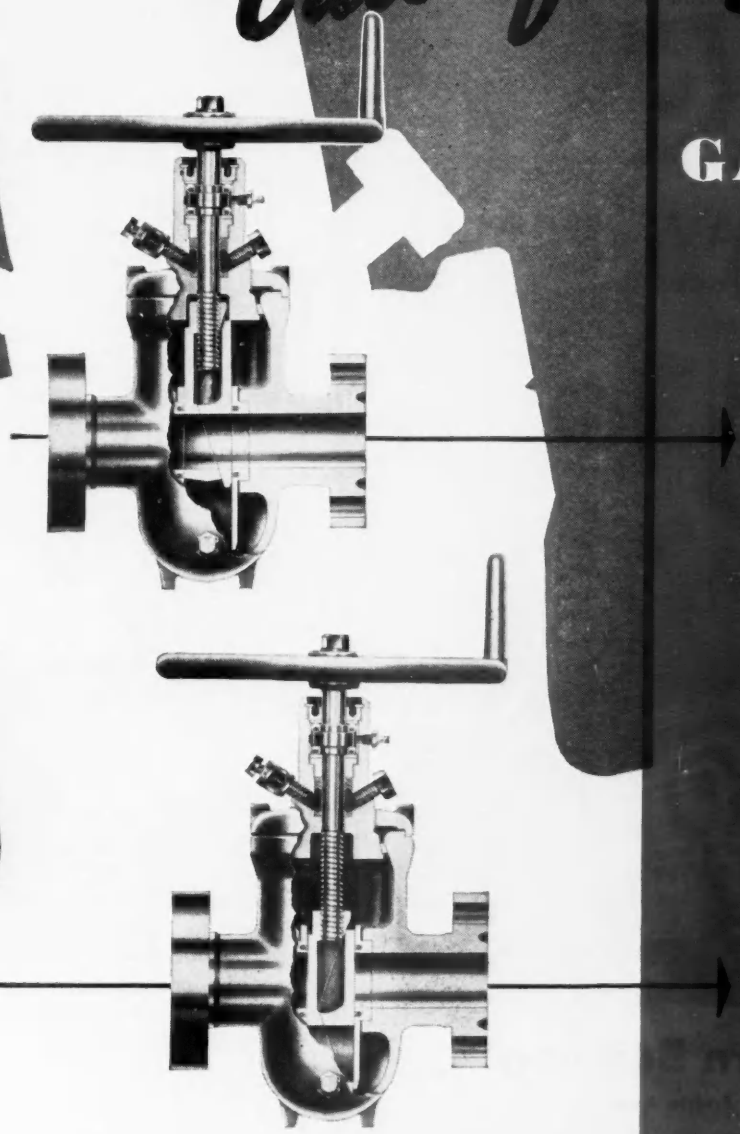

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## More Tankers Being Built Than All Othes Type Ships

More oil tankers by tonnage are under construction throughout the non-Communist world than ships of all other types combined, according to a survey of the Shipbuilders Council of America. New tankers now building aggregate 5,693,015 gross tons, compared with 4,869,200 tons of other vessels. The tanker tonnage now on shipbuilders' ways is equal to nearly one-third of the 17,095,000 gross tanker tonnage represented by 2138 vessels on the fleets of the world at the end of 1950.

Largest number of the tankers in commission at the end of last year were under flags of the British Commonwealth of nations, totaling 543 vessels amounting to 4,108,000 gross tons. U. S.-flag tankships were second in number at 471 vessels, and largest in tonnage at 4,282,000 gross tons. In size of fleets, Norway and Panama ranked third and fourth, the former with 293 tankers of 2,632,000 gross tons, and under Panamanian registry there were 182 vessels of 1,735,000 gross tons.


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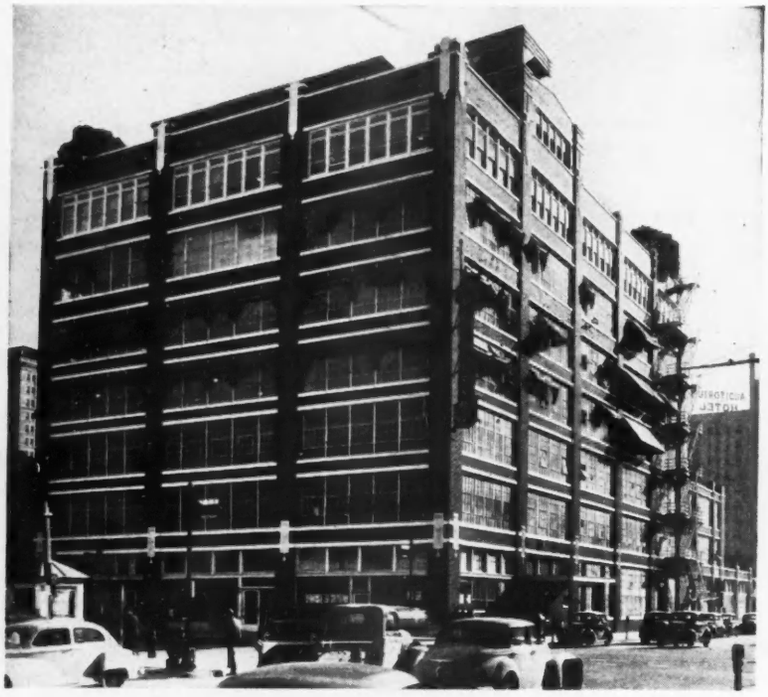

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## Standard Affiliate Receives French Exploration Permit

The first significant exploration effort in France in postwar years by private foreign capital appears in the making with a decree of the French government authorizing Standard Francaise de Pétroles to explore for oil in Southwest France. The permit is for a five-year initial period, and under French law is subject to renewals for two terms of five years each. It covers an area of 6809 square miles in the departments of Gironde (Bordeaux), Charente-Maritime (La Rochelle) Darelogne (Périgueux), Lat-at-Garonne (Agen) and Landes (Mont-de-Marsan).

Standard Francaise is controlled by United Petroleum Securities Corporation, in which Standard Oil Company (N.J.) has the largest interest with participation by Gulf Oil Corporation and The Atlantic Refining Company. Minority stock of SFP is publicly owned in France and the decision to request an exporation authorization came largely at the insistence of French stockholders with the blessing of the government. SPF operates a 45,000-barrel daily refinery at Port Jerome.

## Manabi Completes Initial Producer in Ecuador Area

Manabi Exploration Company registered its inital successful completion in Ecuador in July. Tigre 45, in El Tigre field, flowed 440 barrels of 40-gravity oil daily through one-fourth-inch choke. The well was drilled to 3392 feet, plugged back, and produced from Atlanta sandstone at 2135 feet.

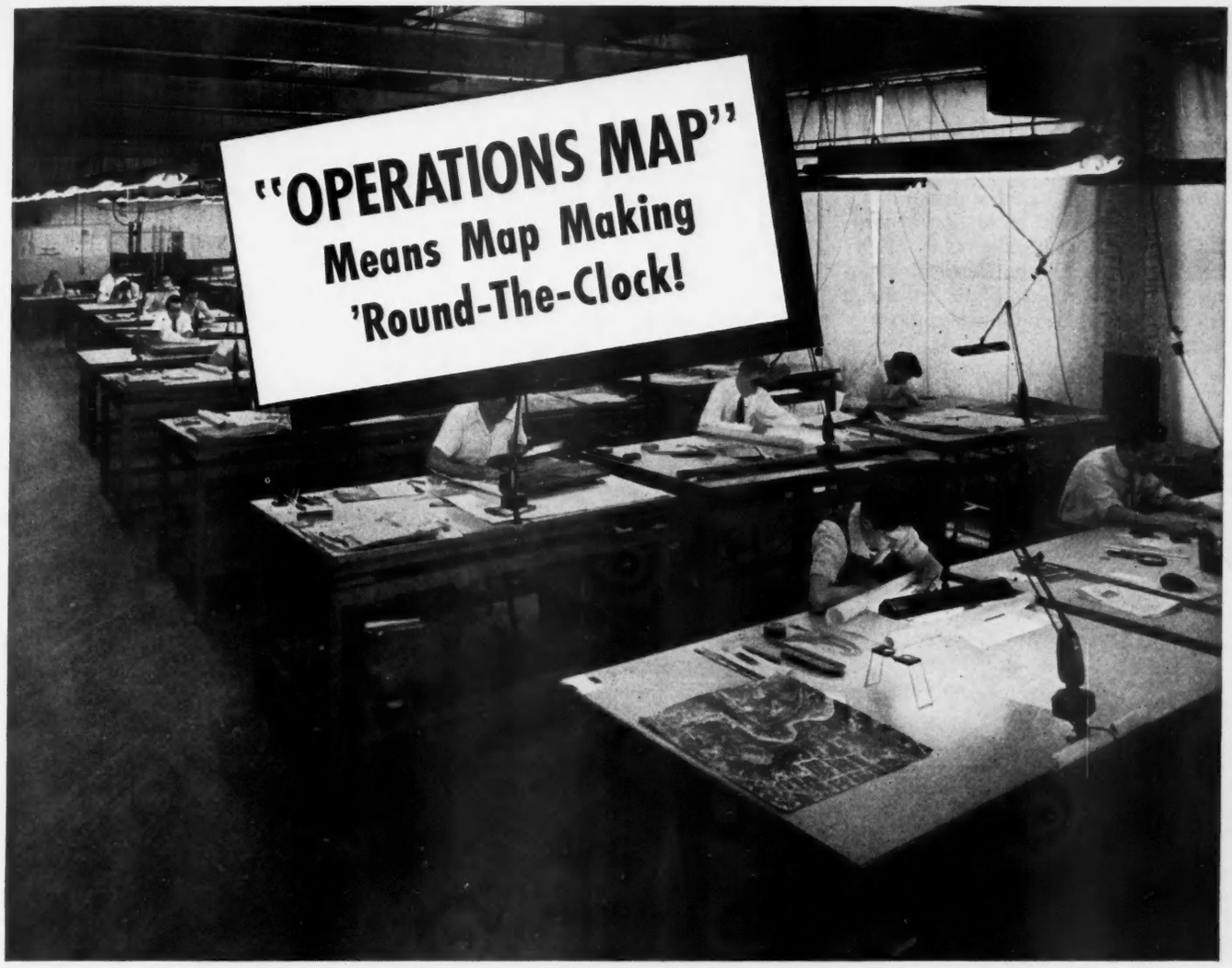
Manabi's daily output reaches approximately 2000 barrels from this field, with 500 barrels a day going to Ecuadorean markets and the remainder exported.

## University of Alberta To Have Its Own 'Well'

The first "oil well" to be drilled within Edmonton's city limits may soon appear on the University of Alberta campus.

But the well never will be completed as a producer.

The university will ask the Alberta Petroleum Association to arrange for the drilling of a "test hole" to be used for demonstration purposes in U. A.'s petroleum engineering course.




NEW exploration and development programs call for maps—*fast!* And AERO mapping—with its speed, accuracy, and ability to work "round-the-clock"—is the answer.

That's why AERO maps for oil companies all over the world. AERO's staff of mapping experts (more than 200 men) deliver dependable topographic maps *months ahead of ground schedules.* AERO mapping is not slowed by rugged terrain . . . compilation is not limited to daylight hours in the field. AERO mapping can go forward night and day.

AERO has made more airborne magnetometer surveys than anyone else—nearly a half million miles for minerals and oil. These aerial surveys have helped geologists direct ground exploration to areas of greatest interest in the United States, Canada*, Africa and South America.

Oil companies find that AERO produces topographic maps of greater accuracy and with more detail than ground methods—good reasons why they rely on us to speed their work. When AERO does the job, your own staff is available for engineering designing and planning.

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## Western Germany's Crude Processing Rate Spirals

At the beginning of 1951, the throughput capacity of Western German mineral oil refineries and hydrogenation plants totaled approximately 36,748,400 barrels annually, according to a compilation drawn up by the Arbeitsgemeinschaft Erdoelgewinnung und-verarbeitung, an industrial union for crude production and processing. In addition, 1,621,000 barrels of lubricant distillates and 1,844,500 barrels of crude gasoline can be refined in the processing plants for semi-finished products.

The mineral oil processing industry increased its crude intake capacity by 9,187,100 barrels in the course of a year. Currently, the Federal Republic could theoretically cover its total mineral oil requirements, which are rising steadily, from its own plants' output based on German and foreign crude. Actually, however, peak quantities of various finished products, such as diesel oil, motor gasoline and some basic oils which are not produced in sufficient quantity, must be imported.

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## Hungarian Oil Saboteurs Cause Diversion of Crude

Sabotage by Hungarian oil refinery workers has forced the Russian Oil Commission, established in Budapest early this year, to order the shipment of 80 percent crude produced in Hungarian fields to Odessa, via the Danube River and Black Sea, with lighters. The oil will be refined in Russian refineries.

Production of Hungarian fields in the Balaton river zone showed an increase of 763,000 barrels monthly for the first half of 1951, reports claimed. This increase led the Russian Oil Commission in Budapest to ask the Hungarian government to develop the drilling and oil field equipment industry.

## Shell's British Borneo Test Under Way, Another Planned

Shell Oil Company is drilling two test wells at Bulak Setap and at Subis in Sarawak, British Borneo. Sites of both explorations are approximately ten miles inland, south of the Miri field.

At Subis, drilling was reported under way, with equipment being transported by boat up the Niah river. At Bulak Setap, the lack of a navigable river has caused the construction of a 30-mile road to the location, delaying the spudding-in.

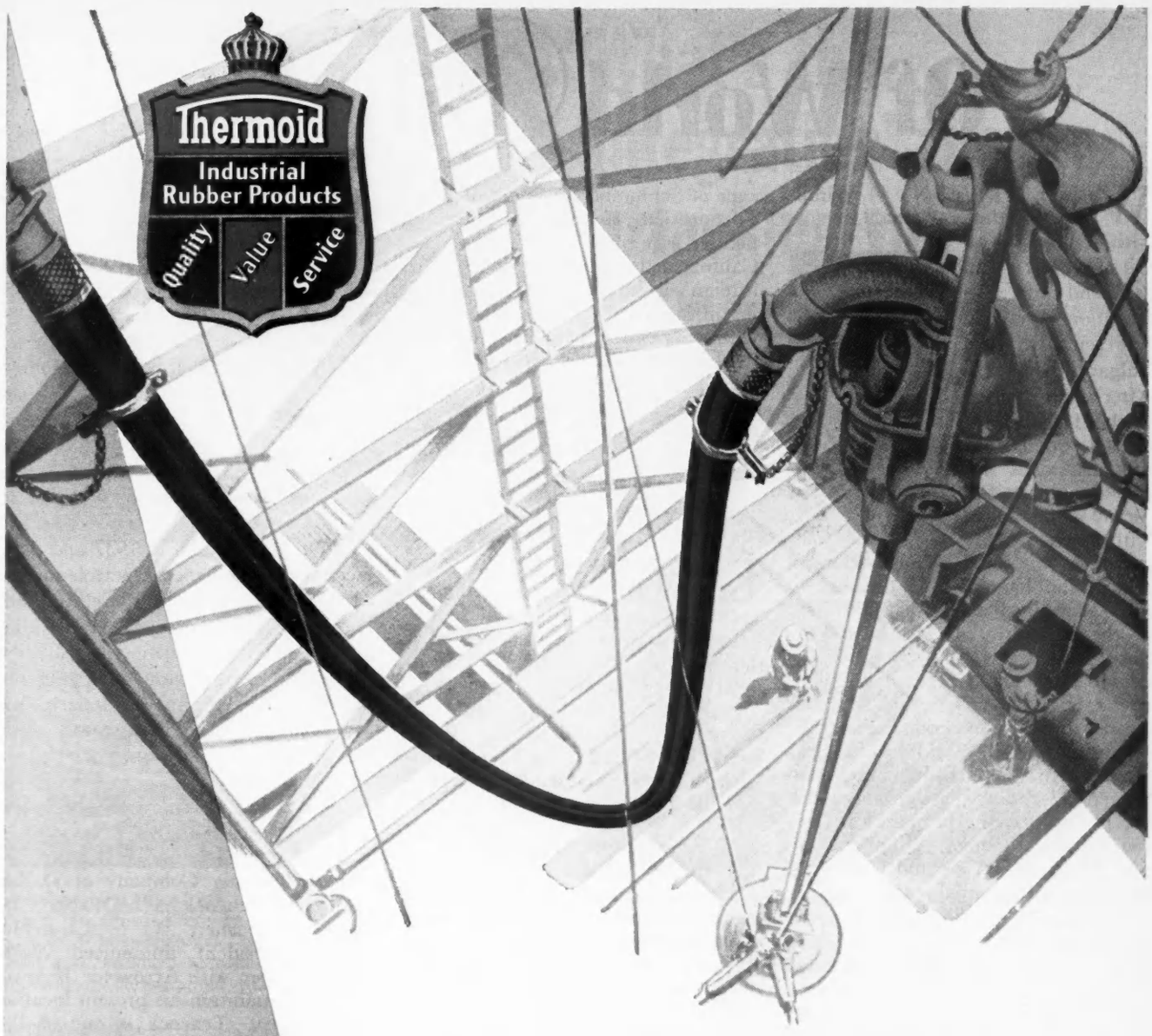
Geological and geophysical parties are reported covering wide sections of Sarawak territory.

## Australia PIB Is Set Up

Petroleum Information Bureau (Australia) now is in operation at Melbourne following its registration under the Business Names' Act. Heading the bureau as director is M. T. Lloyd, who was managing director of Commonwealth Oil Refineries until his retirement 18 months ago. Executive officer of the bureau is A. W. Colley, former deputy chief information officer to the Ministry of Works, London. Objective of the new organization, as with its counterpart in London, is the collection and dissemination of petroleum industry information within its area.

## BOC Blends Fuel in Burma

For the first time, a new high-grade, anti-knock gasoline produced, refined and blended at Chauk by the British Oil Company, Ltd., is available in central and upper Burma.




## Powerflex Rotary Hose Is Pre-tested Under Tougher Than Field Conditions

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But Thermoid Powerflex can take it. Because, like all Thermoid products, it is made with an extra margin of safety and endurance.

The tube is oil-and-abrasive resistant synthetic rubber, reinforced with steel cables and pre-stretched fabric. Cover resists aging, abrasion, cracking. Couplings are built in, and anchored securely for the life of the hose.

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# Of World Oil Men

WALTER J. FENNY of Winnipeg, Manitoba, Canada, is now with Deep Rock Oil Corporation as Land and Exploration division representative in Calgary, Alberta. After a short period in the Tulsa office, he will be located at Calgary. A native of Canada, Dr. Fenny is acquainted with the laws of the provinces of Alberta, Saskatchewan and Manitoba and is a member of the Manitoba bar. He is a graduate of the University of Manitoba Law School and received his doctor of law degree from the University of Chicago. His oil background includes leasing and title experience.

Walter J. Fenny

During World War II, Dr. Fenny served with the Canadian army and retired after five years' service with the rank of major. He taught at Centennial High School, Winnipeg, before his army service, and was active in various educational associations.

ROGER HENQUET has joined The Superior Oil Company's Foreign department. A former executive vice president and general manager of Schlumberger Well Surveying Corporation, Henquet has been appointed vice president and director of California Investments Limited, the foreign subsidiary of Superior operating in the Middle East. California Investments controls Superior's interest in International Marine Oil Company Limited.

Henquet is in Europe, and will eventually establish his headquarters there. Before joining Superior and until his resignation July 1, 1951, Henquet had been with the Schlumberger organization for 22 years.

KEPLINGER AND WANENMACHER, Tulsa, Okla., petroleum engineering firm, will make a reservoir and operational study of the Digboe pool northeast of Calcutta near the Burmah-China border for the Burmah Oil Company. Henry Keplinger, who will handle the field work, has left for India. Later, he will visit other oil producing areas in the Middle East.

STEWART BARCLAY has returned to the U. S. from Mexico City, where he was chief geologist for Mexican American Independent Oil Company (CIMA) for the past two years, and now is chief geophysicist for Tennessee Gas Production Company.

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W. D. C. MACKENZIE, assistant manager of Imperial Oil Limited's Western Canadian producing division for the past three years, has been appointed division manager. He succeeds R. B. Curran, resigned.

A native of Macleod, Alberta, Mackenzie joined Imperial's Geological department at Calgary in 1936 following graduation the previous year from the University of Alberta with a bachelor of science degree in mining engineering. He took charge of subsurface geological work in the Turner Valley field in 1937 and later was transferred to the petroleum engineering department there. In 1942 he joined the Canol project, working with the U. S. government and, after World War II, became chief engineer of Imperial's Producing department. He was advanced to assistant manager of the western producing division in 1948.

T. P. BARTLETT has been named Canadian manager of Arrow Drilling Company of Dallas, and O. H. Peacock has been appointed head toolpusher, W. S. Churchill, Arrow president, announced. Bartlett has been with Arrow for 16 years and will maintain his present location in Calgary. Peacock is one of the company's first pushers in Canada.

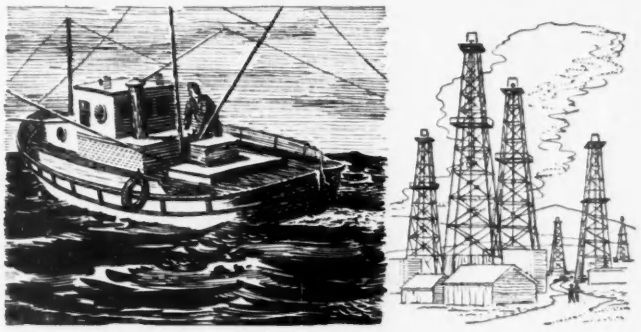
A. J. SINGLETON has been elected a director of California Texas Oil Company, Ltd., and of the Bahrein Petroleum Company, Ltd., Singleton, Caltex vice president, was a director of the Petroleum Board in England during World War II. He has been in the oil business since 1924, starting with Galena Signal Oil Company (of Ireland) Ltd. He subsequently became managing director of the English subsidiary of The Texas Company. At the close of World War II, he was named assistant general manager of the foreign sales division; in 1947, when Caltex acquired the European interests of The Texas Company, he joined Caltex as assistant vice president.

J. DONALD MacGREGOR of the International Petroleum Company, Ltd., has been transferred to Calgary, Alberta, Canada, as staff geologist with Imperial Oil Limited.

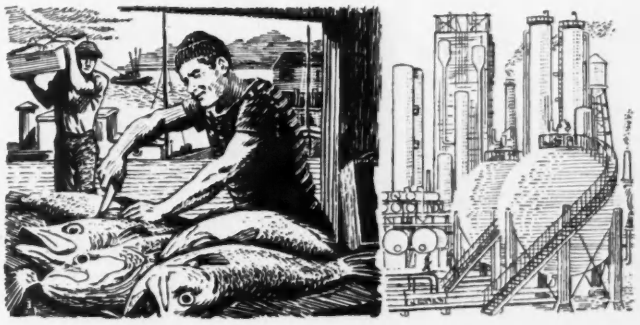
# "What's this 'integration' they're attacking you for?"

**One of the complaints** *now made about big companies like Standard Oil Company of California is that they practice "integration". This word is made to sound so evil that you may wonder what it means as it's used in this case.*

**The fact is that integration is common** in American businesses both large and small. They use it as a natural part of their system of increasing efficiency, cutting costs and improving products. Integration doesn't make a *good* company *bad*. To understand integration at a glance, look at this parallel:

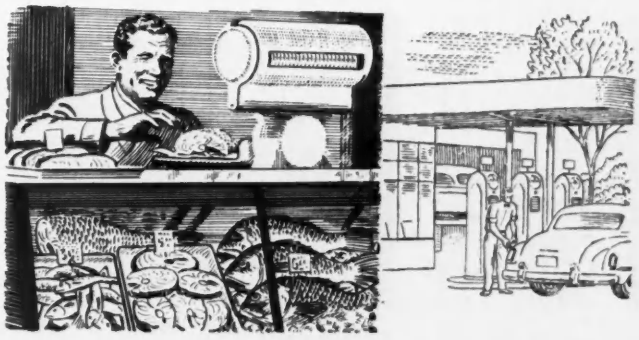


**A fisherman takes his boat** onto the ocean and makes his catch. Standard discovers oil and brings it up out of the ground. If both then *sell*—the fisherman to a buyer at wharfside, and Standard to some buyer at the well—there's no integration. But suppose each takes the next step . . .



**When the fisherman cleans his own fish,** he has become an integrated business. So, too, Standard. Like him, we work to put the product into the form you want. We refine the crude oil we ourselves produce—turn it into gasoline, lubricants, chemicals, and all the rest. This is integration.

**If the fisherman now carries** his cleaned catch to the market-place, he is further integrated, for he is now also in the transportation business . . . as is Standard when we operate our own pipelines and tankers to carry oil from well to refinery, or refined products to areas where they'll be used.



**And if the fisherman then sells his product** through a store of his own, he completes his integration. Standard does it, too, through Company-owned stations (about 1 in 7 stations where Chevron gasolines are sold). Integration helps us do better for you and the nation, and so for ourselves.

*I'd Like to Know . . .* Many people write to Standard asking pertinent questions about the Company. We answer all letters individually, but some points seem of general interest. We take this way of discussing them for every one. If you have a question, we urge you to write in care of: "I'd Like to Know," 225 Bush Street, San Francisco 20, California.

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# Men in the Industry NEWS

George E. Burpee

C. P. Bristol

**George E. Burpee** has been named production manager for Shell Oil Company in Houston succeeding **C. P. Bristol**, who has been transferred to Tulsa to take over duties as production manager there. Bristol replaces W. H. Burke, who has moved to New York in an administrative capacity.

Bristol, a veteron of nearly 20 years with Shell, received his degree in oil field management from the University of Oklahoma and started working in 1931 as a rodman in the East Texas fields around Kilgore, Texas. Before being named Houston area production manager in 1950, he had been production scout, assistant exploitation engineer, manager of several districts, East Texas division manager and chief exploitation engineer for the Houston area.

Burpee, a graduate of the University of Wisconsin, started with Shell in 1932 as a trainee in the company's Kilgore production department. He was division exploitation engineer in the Texas Gulf area, becoming area production manager in Houston in 1946. In February, 1950, he was transferred to Calgary, Canada, where he was production manager until his present assignment in Houston.

**J. T. Dickerson**, Midland, Texas; **W. A. Alexander**, Tulsa; **Bouwe Dykstra**, New Orleans; and **E. G. Robinson**, Calgary, have been named vice presidents of Shell Oil Company.

Appointment of the senior representatives as vice presidents is in line with the company's plan to decentralize the exploration and production activities.

Also announced was the promotion and transfer to New York from Houston of **R. W. Bond**, who was named manager, head office production; and **F. A. Nelson**, manager, head office exploration. They will assist **A. J. Galloway**, Shell's vice president in charge of all exploration and production activities.

**James H. Brickell** has been named district landman in the Colorado-Utah-Arizona district of The California Company's Western division, and will have headquarters at Grand Junction, Colo.

**C. C. Denny** was named division development geologist for the Western division, with headquarters at Denver.

**J. V. Wilson, Jr.**, was appointed district landman of the Mississippi-Alabama-Georgia-Florida district of the Southeastern division, with headquarters at Jackson, Miss. Also at Jackson, **S. W. Totten** has been named district exploration superintendent.

**Robert N. Sears**, who recently returned from Washington, D. C., where he was on loan to the Petroleum Administration for Defense, has been appointed assistant to the executive staff of Phillips Petroleum Company, according to announcement by **K. S. Adams**, chairman, and **Paul Endacott**, president.

Robert N. Sears

Sears will assume special duties assigned by Adams, Endacott, **Stanley Learned**, executive vice president, **W. W. Keeler**, vice president and assistant to the executive vice president, and **J. E. Bogk**, chairman of the operating committee.

Sears was assistant to the president of Wasatch Oil Company in Salt Lake City, Utah, when it was purchased by Phillips in 1947. He also served as chairman of the Wasatch operating committee. Joining the economics department of Phillips in 1948 he worked on many special assignments, acting as Phillips representative in American Independent Oil Company matters.

•

**A. E. Oldham**, vice president and chief geologist of American Liberty Oil Company, Dallas has resigned, and will open an office in Dallas as a consulting geologist.

•

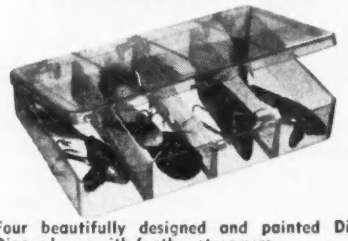
**L. G. Chombart**, well log consulting engineer, has joined Amstutz and Yates, Inc., consulting petroleum engineers and geologists, Wichita, Kansas. He formerly was with Schlumberger Well Surveying Corporation, and later worked for several months with **Dr. R. G. Hamilton**, Tulsa.

•

**Herbert F. Miller**, retired vice president of The Carter Oil Company, has been appointed district manager of the Crude Oil department of the Rock Island Refining Corporation, with headquarters in Tulsa.

•


**The *Perfect* CHRISTMAS GIFT**



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For over 4 years, a rugged International TD-14 has been digging slush pits, clearing land, and tackling other tough excavating jobs for Nile Bunting in the Michigan oil fields.

This kind of work usually hikes up a tractor's upkeep, but the operating costs for this International crawler make Bunting beam. Here's what he says about it:

"My TD-14 has cost me only 5½ cents an hour for repairs and parts in the 6,834 hours it has worked for me. It's over 4 years old now, and my figures show I've spent just $384.80, and that even includes one new bulldozer cutting edge. That's the kind of performance I go for!

"The tractor operates in temperatures as low as 40 below zero, and it starts every time the battery turns it over. The way this baby keeps running, I guess we are going to grow old together."

How about you? Ask your International Industrial Distributor to show you how International power is making the toughest jobs pay off. Have him also tell you where you can see an International crawler in action in your vicinity. Then take a good look at the records—you'll see International delivers Power That Pays!

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## MEN IN THE INDUSTRY NEWS

Thomas A. Atkinson

Edward S. Hochuli

**Thomas A. Atkinson** has been named assistant manager of Rocky Mountain operations for General Petroleum Corporation's Production department, and will have headquarters in Casper, Wyo. **Edward S. Hochuli** replaces Atkinson as manager of the corporation's Industrial Relations department, with headquarters in Los Angeles.

Atkinson first went to work for the company in 1926 as a part-time employe. After receiving a mechanical engineering degree from the University of California in 1933, he worked in the Kern oil fields as a well puller, helper and gauger. He was assigned to engineering work in 1938 and became assistant to the Southern division superintendent of the Production department in 1944. Since 1947 he has been in Industrial Relations work.

Hochuli joined General Petroleum after serving five years in the Navy. He holds a degree in mechanical engineering from the University of California.

•

**H. H. Bradfield,** formerly district geologist at Wichita Falls, Texas, West Texas division of the Producing department, The Texas Company, was promoted to senior geologist on the manager's staff of the Producing department with headquarters at Houston.

He is succeeded as district geologist by Harvard Giddings, formerly geologist in the Wichita Falls district office.

Bradfield received the A.B. and M.A. degrees in geology at the University of Indiana. After working for Shell Oil Company for two years, he returned to the University and was awarded the Ph.D. degree in geology in 1933. He started with The Texas Company in the Wichita Falls office as a junior geologist in 1935. The next year he was transferred to Fort Worth as a regional geologist. He was appointed district geologist at Wichita Falls in 1948.

Giddings studied at the University of Wisconsin. He was employed by The Texas Company as a surface geologist in 1937 and worked for several years in West Texas and New Mexico. Later he was transferred to Wichita Falls, where he has worked as a subsurface geologist.

•

**George Hetherington** has been appointed staff reservoir engineer in the Pittsburgh office of the Production department, Gulf Oil Corporation.

Hetherington will engage in technical studies related to improving the efficiency of crude recovery, and will work in the office of the Technical Assistant to the head of the Production department.

Hetherington was graduated from the University of Colorado in 1928 and did graduate work at the University of Oklahoma and the Colorado School of Mines. He joined Gulf in September, 1945, as staff reservoir engineer at Los Angeles.


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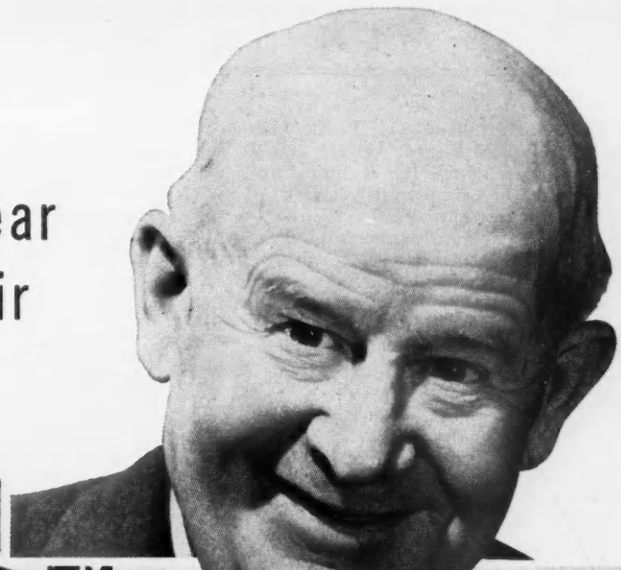

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Why not, right now, place your orders for Homelite Carryable Pumps and Generators. Sure deliveries are somewhat delayed . . . as it is with all good *wanted* equipment. But an order today might save the day in the future. You'll have pumps and generators handy . . . and the very best, Homelites.

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**Mac Donald Oliver, Jr., V. B. (Buddy) Harris, Harrold Eugene Wright** and **R. W. Russell** have joined the technical staff of San Juan Oil Company, Dallas.

Oliver, the new chief engineer, is a graduate petroleum engineer of Texas A. & M. College, and was formerly with Cable and Stine, Wichita Falls.

Harris, formerly employed by Core Laboratories, Barnsdall Oil Company and Harper-Turner, is chief production engineer for San Juan. He is a petroleum engineering graduate of Texas A. & M.

Production Engineer Wright is a graduate engineer of Texas Technological College, and was district engineer, West Texas district, Hiawatha Oil and Gas Company.

Russell is a graduate geologist and petroleum engineer from Texas A. & M. and was an exploitation engineer for Shell Oil Company in West Texas.

•

**Jack McKenna** has been named safety director of Lion Oil Company, El Dorado, Ark. He has been assistant safety director since 1948, and acting safety director since the death of **J. R. Gordon.** McKenna has been with the company 18 years.

Dan M. Reed

J. T. Durbin

**Dan M. Reed** has ben named division office manager for Stanolind Oil and Gas Company's Central division, Oklahoma City, and **J. T. Durbin** has been appointed to a similar position in the Rocky Mountain division, Casper, Wyo.

**Robert F. Wyly,** division industrial relations superintendent, formerly at Oklahoma City, has been transferred to the North Texas-New Mexico division, Fort Worth. He replaces **A. R. Johnson,** who was transferred to the Rocky Mountain division as division industrial relations superintendent. Wyly was formerly in the Central division.

**Albert D. Ellis** has been named assistant chief paleontologist in the Houston division office. Ellis joined Stanolind in 1935, and has concentrated on paleontology of the Gulf Coast area. He has a B.S. degree in petroleum engineering from Louisiana State University.

In 1931, Reed joined Stanolind as a clerk in the Acounting department at the Tulsa general office. He has advanced through the department to the position of assistant comptroller in 1945, and in January, 1951, was named division accountant for the Central division.

Durbin, who was formerly assistant comptroller in Tulsa, has been associated with Stanolind since 1928, when he joined Dixie Oil Company, a predecessor of Stanolind.

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Schroeder, a graduate of Colgate University in geology, joined Sun's Production department at Beaumont in 1936, and transferred to the Geological department in March, 1937. He was made division chief geologist in 1948.

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FIELD EQUIPMENT

Is your oil field equipment full of fight for the long, tough production battle ahead . . . fully protected against sudden failures? With delivery of new equipment often months away, you may soon find your old equipment worth its weight in gold.

One of the easiest and surest ways to restore new pep and stamina to your old equipment is to replace inferior or worn bearings with new, industry-proven Aetnas. Years of specialization in designing and engineering oil equipment bearings has earned an ever widening recognition for Aetna extra-quality and reliability in all types of applications . . . rotary tables . . . crown and traveling blocks . . . catheads . . . plug valves . . . safety blocks . . . casing swivels . . . draw works drums . . . and in the mighty motor trucks that do the heavy hauling.

Greater round-the-clock, month-after-month dependability under abusive oil field demands results when Aetna bearings go to work in your equipment. Why not send your prints for recommendations and estimates? No obligation.

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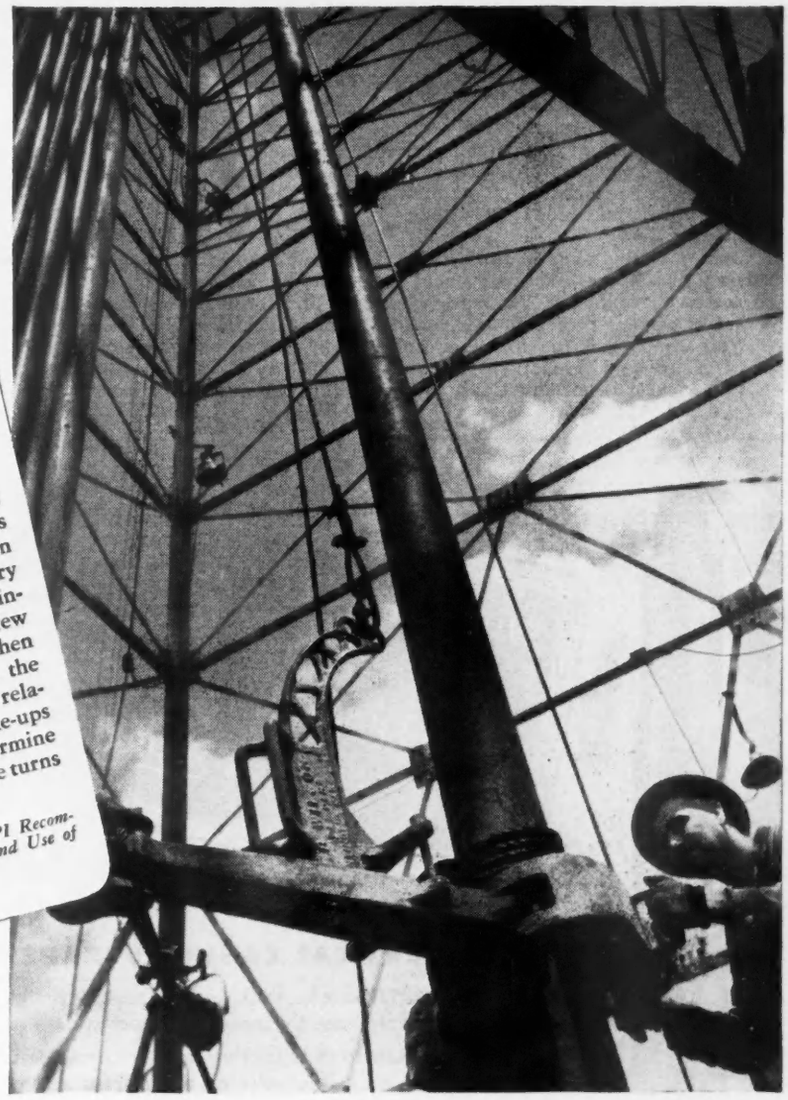
# How to test tong-up tightness

## Reminders of Good Casing Practice

When tonging casing, the joint should be made up at least three turns beyond the handtight position. When using a spinning line, it is necessary to compare handtightness with spin-up tightness. Make up the first few joints to the handtight position, then back off and spin up joints to the spin-up tight position. Compare relative position of these two make-ups and use this information to determine when the joint is made up three turns beyond handtight.

*Reprinted by permission from "API Recommended Practice RP 5C1: Care and Use of Casing, Drill Pipe and Tubing."*




# TONG UP TIGHT JOINTS
## with Republic Electric Weld Casing

*The more uniform the casing wall thickness, the higher the joint strength and fewer the pull-outs.*

In Republic Electric Weld Casing, wall thickness and roundness always are uniform. Made of close-tolerance, flat-rolled steel, it is cold formed to tubular shape and joined with a weld that's as strong as the wall. Thus, when those clean, accurate threads are cut, a uniform depth of tough steel remains beneath the root line all around the pipe. No pull-out-inviting thin spots occur.

What's more, it is made from high ductility steel, fully normalized for uniform structure and cold sized to further increase its high yield strength. It offers strong resistance to external pressures . . . helps avoid the dangers of collapse.

You can hold the line against pull-outs and collapse by specifying that your strings be run with Republic Electric Weld Casing and Tubing.

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GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

REPUBLIC *Electric Weld*
NORMALIZED CASING AND TUBING

REPUBLIC STEEL

**Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes**

**Mac Donald Oliver, Jr., V. B. (Buddy) Harris, Harrold Eugene Wright** and **R. W. Russell** have joined the technical staff of San Juan Oil Company, Dallas.

Oliver, the new chief engineer, is a graduate petroleum engineer of Texas A. & M. College, and was formerly with Cable and Stine, Wichita Falls.

Harris, formerly employed by Core Laboratories, Barnsdall Oil Company and Harper-Turner, is chief production engineer for San Juan. He is a petroleum engineering graduate of Texas A. & M.

Production Engineer Wright is a graduate engineer of Texas Technological College, and was district engineer, West Texas district, Hiawatha Oil and Gas Company.

Russell is a graduate geologist and petroleum engineer from Texas A. & M. and was an exploitation engineer for Shell Oil Company in West Texas.

•

**Jack McKenna** has been named safety director of Lion Oil Company, El Dorado, Ark. He has been assistant safety director since 1948, and acting safety director since the death of **J. R. Gordon.** McKenna has been with the company 18 years.

Dan M. Reed

J. T. Durbin

**Dan M. Reed** has ben named division office manager for Stanolind Oil and Gas Company's Central division, Oklahoma City, and **J. T. Durbin** has been appointed to a similar position in the Rocky Mountain division, Casper, Wyo.

**Robert F. Wyly,** division industrial relations superintendent, formerly at Oklahoma City, has been transferred to the North Texas-New Mexico division, Fort Worth. He replaces **A. R. Johnson,** who was transferred to the Rocky Mountain division as division industrial relations superintendent. Wyly was formerly in the Central division.

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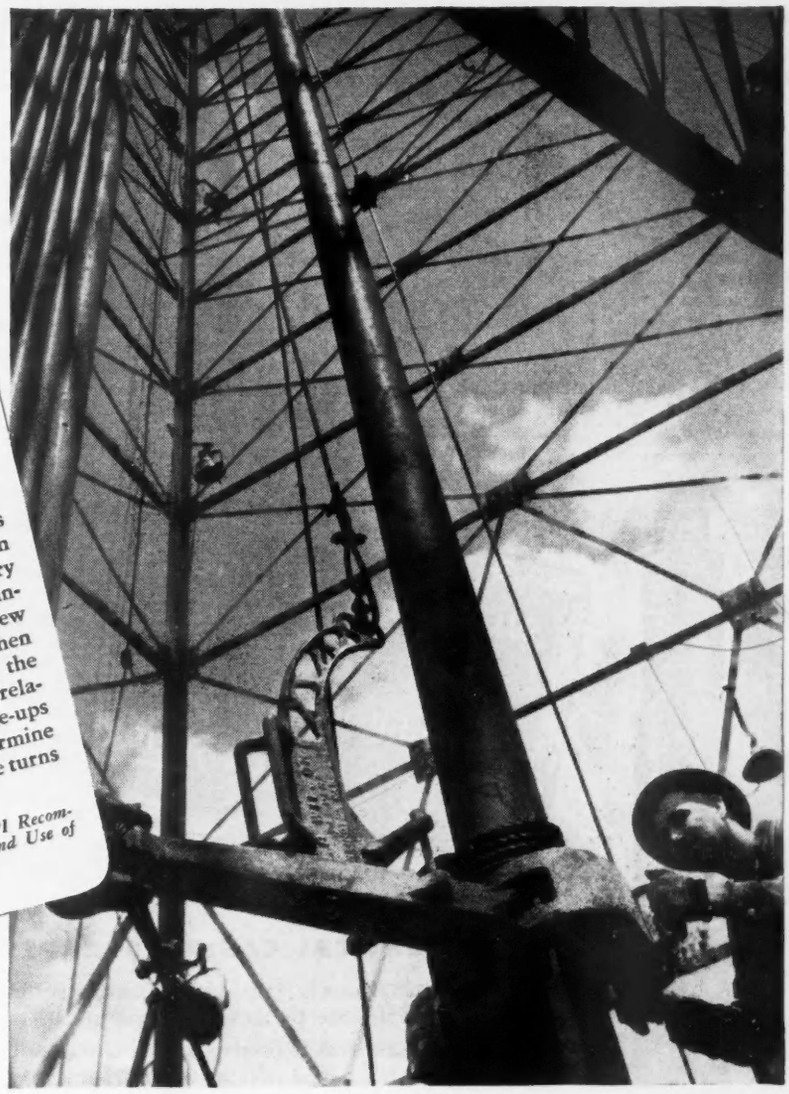

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**Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes**

**G. A. Carmichael,** formerly area production superintendent at Beaumont, Texas, for Gulf Oil Corporation, has been appointed zone superintendent of production (drilling and production) for Zone 1 Texas Gulf Coast.

A small office building on Holmes Street Road near the Pierce Junction oil field has been completed and Zone 1 operations are now headquartered there. In this connection Gulf announced the following additional transfers and promotions:

**J. P. Weichert** from Gulf Coast district petroleum engineer (drilling fluids) at Houston, to assistant zone superintendent of production (drilling operations) for Zone 1;

**W. H. LeGrand** from assistant area production superintendent at Beaumont to assistant zone superintendent of production (production operations) Zone 1;

**S. H. Miller** from production and proration engineer Gulf Coast district, Houston, to zone petroleum engineer, Zone 1;

**Hardy H. Head** from assistant area production superintendent at Beaumont to area production superintendent, Beaumont;

**Karl Carter** from assistant area production superintendent at Pierce Junction to area production superintendent at Luling;

**P. C. Henry** from area production superintendent at Luling to assistant area production superintendent, Pierce Junction area;

**Fred Sherron** from field foreman at Goose Creek to assistant area production superintendent at Beaumont;

**Tom Slack** from area petroleum engineer at Hull to field foreman at Goose Creek;

**R. R. Ball** from Zone 3 chief clerk at Kilgore to Zone chief clerk, Zone 1;

**Z. C. Ballinger** from area petroleum engineer, Pierce Junction, to assistant zone petroleum engineer, Zone 1;

**O. G. Gage** from area petroleum engineer, Buras, La., to petroleum engineer (drilling and workovers) Zone 1;

**Randolph Bryant, Jr.** from area petroleum engineer, Beaumont to petroleum engineer (production) Zone 1;

**J. D. Driskell, Jr.** from petroleum engineer, Fannett field, to area petroleum engineer at Beaumont;

**J. H. Russell, Jr.** from petroleum engineer, Pierce Junction field, to area petroleum engineer, Pierce Junction;

**J. G. Ferrell** from assistant area petroleum engineer to area petroleum engineer at Buras;

**R. A. Kilsdonk** from petroleum engineer at Kilgore to area petroleum engineer at Hull;

**V. D. Stone** from petroleum engineer to assistant area petroleum engineer at Buras;

**D. D. Dawson, Jr.** from petroleum engineer (drilling fluids), Houston, to petroleum engineer (drilling fluids) Zone 1;

**R. F. Thomas** from petroleum engineer, Fannett, to petroleum engineer (production and proration), Houston;

**E. E. Johnson** from zone superintendent of warehouses at Harvey, La., to zone superintendent of warehouses at Pierce Junction;

**A. B. Powers** from zone field material supervisor to zone superintendent of warehouses at Harvey; and

**John C. Wick, Jr.** from senior clerk to assistant zone superintendent of warehouses at Harvey.

•

**E. A. McQuade,** vice president of the Equity Corporation, and **William Ewing, Jr.,** associated with Morgan Stanley & Company, have been elected directors of The North Central Texas Oil Company, Inc., New York.

•

**Leslie Moses,** division attorney for Midstates Oil Corporation, Shreveport, has resigned to become executive assistant to the manager of the Land, Lease and Exploration department of Crown Central Petroleum Corporation, Houston. Moses received his law degree from Tulane University in 1924, and practiced law in New Orleans until 1936, when he moved to Houston to join Fohs Oil Company as attorney. In 1942 he was elected secretary and general attorney for Fohs, and retained that position until the company was sold in 1946. He then went to Shereport to join Midstates.

•

**Blakely M. Murphy,** former professor of law at University of Tennessee, has moved to Oklahoma City where he will practice law specializing in oil and gas matters.

**GRANT VERTICAL CASING SCRAPER**

**THREE SETS OF CUTTERS** are held in expanded position against the casing circumference by means of heavy springs . . .

**CUTTERS ARE SPACED** so as to overlap in their contact with the casing, provide the most effective and efficient cutting action, give better fluid return path . . .

**HELICAL DESIGN** of the hard-faced cutting edges provides an efficient shearing-cutting action that completely removes burrs and foreign material from the casing wall . . .

**FOOL-PROOF LOCK** holds cutters securely, yet cutters can be quickly changed in the field when worn.

**EITHER TUBING OR WIRE LINE** can be used for running the Grant Vertical Scraper, and full circulation can be established through the tool if necessary.

**See your nearby Grant Representative for details . . . write for Bulletin 59, or see your 1951 Composite Catalog.**

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| | Bulletin No. |
|---|---|
| Hydrostatic Bailers | 11 |
| Liner Pullers | 14 |
| Pressure Releases | 15 |
| Hydraulic Expansion Casing Scrapers | 17 |
| Rotary Underreamers | 24 |
| Cable Tool Underreamers | 27 |
| Hole Enlargers | 38 |
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| Roller Cutter Shale Bits | 54 |
| Sand Pumps | 55 |
| Well Cleanout Equipment | 57 |
| Wall and Bottom Hole Scrapers | 58 |
| Vertical Casing Scrapers | 59 |

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Main Office and Plant
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Make the PITTSBURGHER your stopping place on every motor trip. Located right in the heart of town . . . easily reached from all major highways. Enjoy the finest in modern facilities, too . . . 400 rooms each with free radio, bath and circulating ice water. Garage service.

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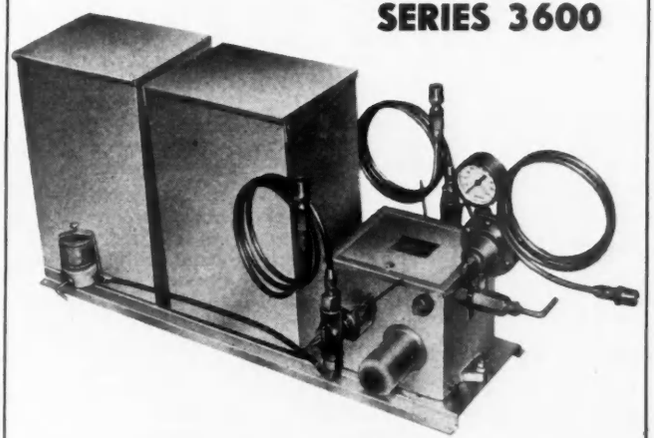
JOSEPH F. DUDDY, MANAGER

## TEXSTEAM

for the finest in

chemical pumps
SERIES 3600



Furnished in several types to meet many requirements. With maximum injection pressure of 3000 psi, Texsteam Series 3600 Injectors are available with single or double heads and tanks, with or without fittings. Volumes range from ½ pint to 40 gallons per day.

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WILMERDING, PENNA.
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**E. F. Kindsvater,** who has been manager of the engineering department of Phillips Petroleum Company, has transferred to the Washington office under the supervision of **R. C. Jopling.** He will work primarily on the procurement and allocation of materials.

**A. H. Riney,** who has been head of the engineering department for 30 years, has resigned as vice president, engineering department and will retire from active duty. Riney will be available however, for consultation by the manager of the engineering department and on specific assignment of the chairman or the president.

**George R. Benz,** who was originally employed in the engineering department 26 years ago and has been in many varied engineering assignments with the company since, will become manager of the engineering department.

**C. K. Buell,** presently assistant manager of the chemical engineering division of the research and development department, replaces Benz as its manager, and **R. C. Cole** will replace Buell as assistant manager. **R. E. Weis** succeeds Cole as superintendent of Philtex Experiment Station.

**L. E. Fitzjarrald,** general superintendent, has been appointed manager of the Production department. **H. H. Kaveler,** assistant to the vice president, has been appointed assistant manager; and **J. M. Houchin,** assistant general superintendent, has been appointed general superintendent.

**C. P. Dimit,** vice president and director of Phillips, will continue as vice president in charge of production.

Fitzjarrald, who joined Phillips in 1919, has been general superintendent since 1944. He has served in the Production department since 1922 when he was appointed chief clerk. Kaveler started with the company in 1936, as assistant section chief in the Production department, before which he served on the faculty at the University of Missouri and George Washington University and was with the Bureau of Mines in Pittsburgh. He became assistant to the vice president of production in 1944.

Houchin joined Phillips in 1933. He has served continuously in the Production department, having been appointed assistant general superintendent in 1944. He is a graduate of the University of Oklahoma.

•

**Edward B. Marsh,** for 13 years hearing examiner with the Federal Power Commission, has been named Washington representative of Transcontinental Gas Pipe Line Corporation. Marsh, a native of North Carolina and a licensed attorney, will have his offices in the Shoreham Hotel, Washington, D. C.

Marsh was the presiding officer in the hearings in the Hope Natural Gas case and the Mississippi River Fuel case. He also wrote the initial decision in the Piedmont Natural Gas case.

•

**R. M. Beatty** has been named administrative assistant, **Ralph Coleman** production superintendent, and **Stewart Barclay** chief geophysicist of Tennessee Gas Transmission Corporation's Gas Supply department.

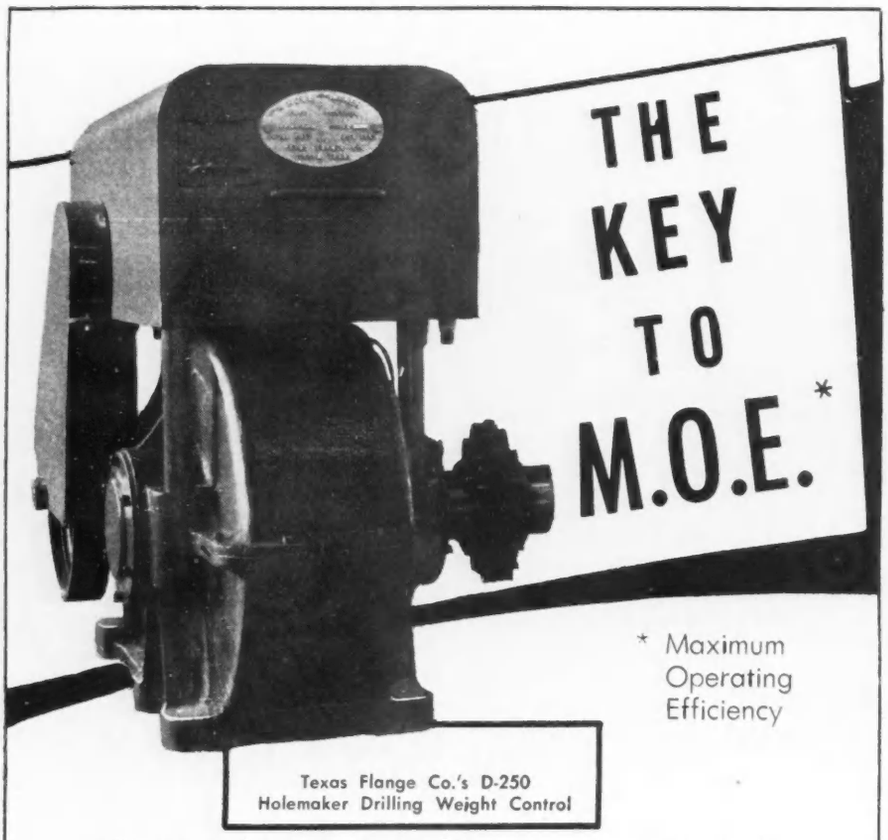
Beatty formerly was chief geologist of the American Republics Corporation. A graduate of Lafayette College, Easton, Pa., and World War II veteran, he has been connected with The Pure Oil Company, Trinity Petroleum Company and Tide Water Associated Oil Company.

Coleman previously was assistant general manager of Mexican American Independent Company in Mexico City and earlier was with the Gulf Oil Corporation. A University of Texas graduate and World War II veteran, he was assigned to an oil exploration project in Alaska both as a Navy officer during the War and later as chief engineer and drilling superintendent of Arctic Contractors, which took the project over from the Navy.

Barclay went to Tennessee Gas from Mexican American Independent Company, Mexico City, where he was chief geologist. A graduate of Louisiana State University, he joined the Geophysical division of Phillips Petroleum Company and later for several years was chief geophysicist of Phillips Oil Company in Venezuela.

•

**Phillip Maverick,** petroleum geologist of the Tulsa office of the Securities and Exchange Commission, has resigned to move to Midland, Texas, and resume his former work in geological exploration.

Texas Flange Co.'s D-250 Holemaker Drilling Weight Control

Rig owners are aware that the key to maximum operating efficiency is keeping constant weight on the bit under all drilling conditions — including coring.

The Texas Flange Company has the answer to weight control problems with the "HOLEMAKER" Drilling Weight Control . . . mechanical hydraulic devices which operate on simple, known principles to keep a constant weight on the bit — automatically.

"HOLEMAKER" Drilling Weight Control can be installed on any rig, old or new, large or small.

SEND US SPECIFICATIONS FOR YOUR RIGS AND WE WILL SEND COMPLETE INFORMATION AND ESTIMATED COST FOR EQUIPMENT AND INSTALLATION.

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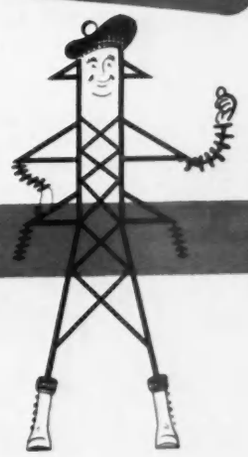
*PEP — Purchased Electric Power

LOW COST POWER
PROVIDES
SAFETY
DEPENDABILITY
ECONOMY



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**HEAVY-DUTY PORTABLE & STATIONARY MODELS**
*Diesel, Gas, Gasoline-powered*

● ONAN oilfield electric plants provide dependable light and power for oil field applications. A complete range of A.C. and D.C. models... all conservatively rated for continuous, dependable service helps you choose the right plant for the job. Lightweight, air-cooled models from 400 to 5,000 watts; heavy-duty, water-cooled, gas-gasoline-driven plants from 5,000 to 35,000 watts. Air-cooled Diesel electric plants 2,500 watts. Water-cooled Diesels from 12,500 to 55,000 watts, powered by IH engines.

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## MEN IN THE INDUSTRY NEWS

**Frank C. Osment**, formerly district geologist at Shreveport, is the new division geologist for Stanolind Oil and Gas Company's Texas-Louisiana Gulf Coast division, Houston. He succeeds **Russell A. Weingartner**, transferred to the Tulsa general office as senior staff geologist.

Stanolind also announced the appointment of **W. L. Templin** as industrial relations supervisor for the General division, Oklahoma City.

Osment was graduated from Birmingham-Southern College in 1939 with a B.S. Degree in geology, and received his M.S. in geology from the University of Illinois in 1941. He then entered the Navy and served until 1945. In October, 1945, Osment joined Stanolind as a geologist at Shreveport.

Templin had been division wage and salary analyst since September, 1948. He joined Stanolind in April, 1940, as a roustabout in the Lucien area in central Oklahoma. He was a member of the Army Air Force from November, 1942, until 1945.

## DEATHS

**Harry Gore**, 72, drilling contractor of Wichita, Kansas, died August 24. He headed a cable tool drilling company credited with drilling more than 1500 wells in Kansas alone. Before going to the Mid-Continent area he had been active in Eastern fields of West Virginia and Ohio.

●

**Jess M. Hester**, 73, pioneer oil well rig builder, died August 29 in Houston. A justice of the peace at the time of his death and a former mayor of Humble, Texas, Hester was associated with Hester Brothers Rig Building Company and had built rigs in oil fields throughout the U. S. and Mexico.

●

**James Fitzgerald, Jr.**, 47, geologist and independent oil producer, Midland, Texas, died August 29 in Washington, D. C. Before moving to Midland in 1933 he was in the Land department of Skelly Oil Company in Tulsa.

●

**Charles M. Cotton**, 67, president of Lomita Oil and Gas Company and vice president and general manager of Jergins Oil Company, died September 3 at Santa Monica, Calif. He had been associated with Jergins since 1922 in oil operations chiefly in the Signal Hill field, Long Beach, Calif. He was a director of the Western Oil & Gas Association.

●

**H. J. Walker**, independent operator and pioneer oil man, died July 17 at Bradford, Penn. He was active in early day development of the Pennsylvania fields and more recently was interested in Mid-Continent water flood operations.

●

**S. M. Carson**, 63, Oklahoma and Kentucky oil operator, died September 1 at Henderson, Ky. A native of Canada, he started as a roustabout at Glenpool field, Oklahoma, worked for The Carter Oil Company, and then became an independent.


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REPRESSURING WITH GAS OR WATER

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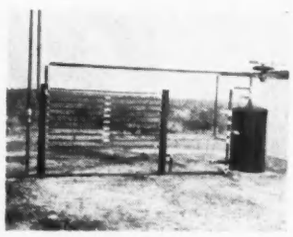

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Sterling Silver Clip with Gold Derrick
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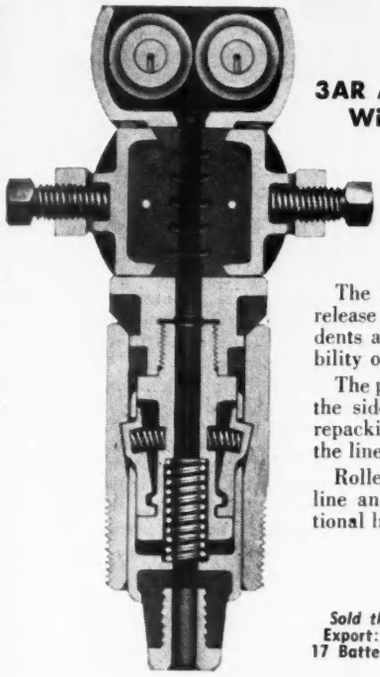
# FOR SWABBING— *Be Sure* IT'S A KING *Be Safe* —FOR CORING



### 3AR Automatic Release Wire Line Stripper

Type 3AR King Wire Line Stripper is the ideal tool for use in swabbing operations.

The positive latch and sure release insure against accidents and eliminate the possibility of breaking a line.

The packing is inserted from the sides of the stripper and repacking is easily done while the line is in the hole.

Roller line guides center the line and outwear the conventional bushing.

*Sold through your supply store*
Export: R. S. Stokvis & Sons, Inc.
17 Battery Place, New York, N. Y.

### 4AR King Type Stripper For Wire Line Coring

Type 4AR Wire Line Stripper is similar to the 3AR, except it is a little larger. Although it can be used for swabbing, its primary use is for wire line coring operations. The 4AR is commonly used with King circulating heads. When required, both the 3AR and 4AR can be furnished with 1½" pipe thread on the bottom for attachment to a trip bar.

See your latest Composite Catalogue for detailed descriptions of other King Tools.

## KING OIL TOOLS

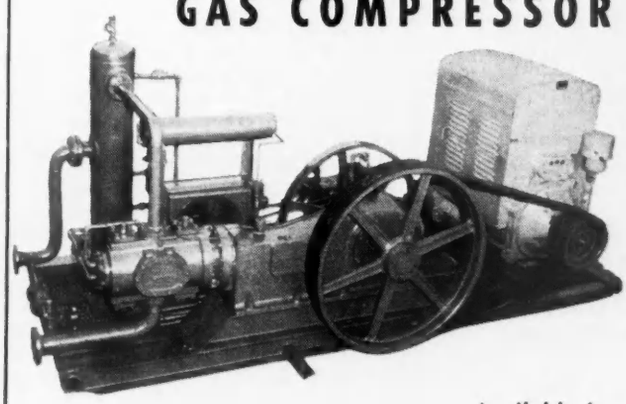
210 Terminal Street — Phone OS 3-3421

HOUSTON 20, TEXAS



## WORTHINGTON

*PORTABLE*
GAS COMPRESSOR



Available in
Capacities to 7,500,000 CFM
and Pressures to 1600 Pounds

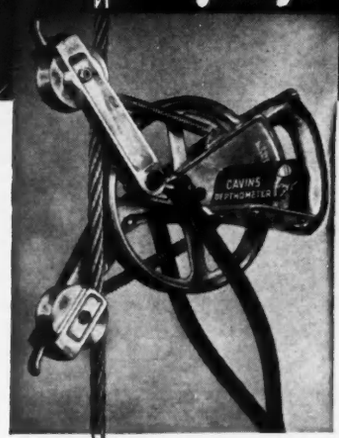
For your requirements, consult our nearest office or Distributor

**A. M. LOCKETT & COMPANY, LTD.**

HOUSTON NEW ORLEANS DALLAS



## *Why Guess* ABOUT WIRE LINE MEASUREMENTS?




- Easy to Carry
- Direct Reading
- Quickly Put on Line
- Accurate Measurements

The Cavins DEPTHOMETER is a simple, compact, direct-reading device that obsoletes "stringing-in" and gives you accurate measurements in very little more time than it takes to make a trip with your bailer. Comes in a handy carrying case (weighs only 17 pounds)—readily taken to any well—put on the line in a few seconds—priced to pay for itself quickly.—Write for illustrated folder.

THE CAVINS CO.
2853 Cherry Ave., Long Beach 6, California

**CAVINS DEPTHOMETER**

# Companies in the News

**SUNRAY OIL CORPORATION** has completed realignment of its Production department supervisors and field offices to decentralize activities. The Mid-Continent producing division includes Oklahoma, Kansas, Texas, Arkansas, Louisiana, Mississippi, New Mexico, Colorado and Wyoming. In the new setup, operating districts mainly correspond to state boundary lines. Each district is headed by a district superintendent and some of the districts have assistant superintendents. Field operations are supervised by the district offices in "areas," representing large segments of field operations within the district, and "groups" which are primarily lease operations within limited areas of state districts. Each of the areas is supervised by a field superintendent, and lease groups are supervised by a lease foreman or group foreman, who may be responsible for a group of leases in an operating area.

Production department personnel in the Mid-Continent division are as follows:

Division superintendent is **J. R. Vandever**, and **John H. Douma** and **C. J. Kerwin** are assistant division superintendents, Douma supervising operations in Arkansas, Louisiana, Mississippi and Gulf Coast Texas, and Kerwin supervising North and West Texas, Oklahoma, New Mexico, Kansas, Colorado and Wyoming.

SOUTH LOUISIANA DISTRICT: headquarters at Lake Charles, **A. E. Hoffman**, superintendent, **J. A. Perry**, assistant superintendent; West Tepetate area: **D. J. Hoover**, West Tepetate, La., field superintendent; Longville group: **H. O. Jones**, foreman.

TRI-STATE DISTRICT: Midway, Ark., **Keith Lindley**, superintendent; Midway, North Louisiana, and Northeast Texas Groups: **J. T. Davidson**, foreman.

CORPUS CHRISTI DISTRICT: Corpus Christi, **A. E. Hoffman**, acting superintendent, **G. E. McClatchey**, assistant superintendent; Corpus Christi area: **J. M. Goodman**, Corpus Christi, field superintendent; Corpus Christi Bay group: **A. O. Miller**, lease foreman.

SOUTH TEXAS DISTRICT: Alice, Texas, **C. E. Wilson**, superintendent, **F. S. Goddard**, assistant superintendent: McFaddin Nordheim area: Nordheim, Texas, **H. E. Fish**, field superintendent; McFaddin and Greta groups: **C. B. Wright**, lease foreman; Nordheim group: **A. E. Meissner**, foreman.

Premont area: Premont, Texas, **C. D. Baker**, field superintendent; West Premont, Seeligson, and London Gin groups: **J. M. Leach**, lease foreman.

Placedo Pierce Junction area: Placedo, Texas, **J. R. Myrick**, field superintendent; Placedo group: **T. Williams**, lease foreman; Pierce Junction group, **R. D. Mapes**, acting lease foreman.

Hebbronville area: Hebbronville, Texas, **J. A. Parry**, field superintendent; Glen group: **R. B. Caskey**, lease foreman; Bruni and miscellaneous groups: **C. L. Fenley**, lease foreman.

NORTH AND WEST TEXAS DISTRIC: Midland, Texas, **Perry A. Gill**, superintendent; Snyder area: Snyder, Texas, **L. L. Peek**, field superintendent; Canyon group: **C. T. McClanahan**, lease foreman.

Odessa area: Odessa, Texas, **L. E. Pruitt**, field superintendent; Levelland group, **F. R. Hunt**, lease foreman; Sherrod group: **N. E. Clegg**, lease foreman; Ector group: **J. S. Newcomb**, lease foreman.

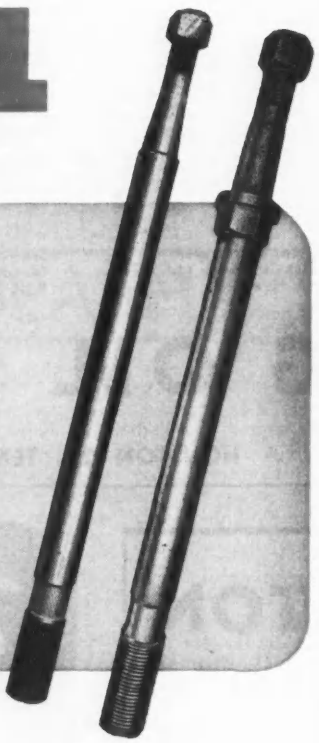
Big Spring area: Forsan, Texas, **C. C. Brunton**, field superintendent; Dora Roberts group: **H. W. Andrews**, lease foreman; K. M. A. group: **O. G. Smith**, lease foreman.

New Mexico area: Hobbs, N. M., **A. S. McQuiston**, field superintendent.

KANSAS DISTRICT: Great Bend, **C. C. Shreve**, superintendent, **F. M. Mc-**


**RED DEVIL**

**"DIA-HARD" PISTON RODS**



***For high pressure abrasive service***

**RED DEVIL Piston Rods are first choice where drilling conditions are severest because of the extreme hardness of the deep HIGH-CARBON wear resistant "DIA-HARD" case, coupled with tough core properties which give the highest tensile strength against breakage. All rods are hardness tested and precision gauged to maintain a world-wide reputation for quality. Write for Catalog No. P-101.**

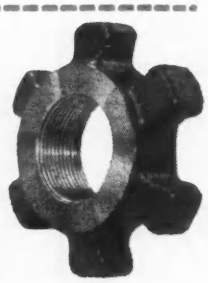
**RED DEVIL PISTON PULLER**

***For tapered type rods***

**The usual practice of removing pistons from rods by blows of a sledge hammer often damages either pistons or rods. A Red Devil piston puller easily and quickly removes badly stuck pistons without injury to either part. All elements are made of finest quality alloy steel, heat-treated for strength and long life. Write for Catalog No. P-106.**

**RED DEVIL PISTON ROD LOCK NUT**

**These "Hammer Lug Type" nuts provide a fast and positive means for locking piston rod in crosshead. Made from alloy steel and heat treated, they will last indefinitely. Face of nut is precision machined for full seating surface at right angles to axis of threads to prevent fatigue stresses in rod. Write for Catalog P-102.**



**Complete information in Composite Catalog or write for price catalogs noted above. Red Devil products are available through your supply store.**

**OIL WELL MANUFACTURING CORP.**

6008 S. Alameda St., Los Angeles 1, Calif.

## COMPANIES IN THE NEWS

**Daniel**, assistant superintendent; Ellis area: Russell, Kansas, **G. D. Boyle**, field superintendent; Hays group: **C. M. Graham**, lease foreman; Russell group: **N. J. Gooch**, foreman; Madison group: **Alva Sutton**, lease foreman.

Burrton area: Burrton, Kansas, **Orville Hilbert**, field superintendent; Sabin group: **E. H. Winesburg**, lease foreman; Rainbow Bend group: **A. D. Passmore**, lease foreman.

Barton area: Bushton, Kansas, **W. D. Poe**, field superintendent; Trapp group: **A. J. Warren**, lease foreman; Bloomer group: **O. M. Light**, lease foreman.

OKLAHOMA DISTRICT: Oklahoma City, **Alvin R. Summers**, superintendent, **V. L. Smith**, assistant superintendent; Seminole area: Wewoka, Okla., **J. F. Dingee**, field superintendent; Allen-Bebee group: **Tom Jacobs**, foreman, **T. C. Anderson**, lease foreman; Earlsboro group: **Parker Sullivan**, foreman, **E. E. Hill**, lease foreman; Wewoka group: **W. A. Drain**, foreman.

Western area: Oklahoma City, **I. T. Simmons**, field superintendent; Comanche group: **A. J. Wise**, foreman, **Paul Anduss**, lease foreman; Oklahoma City group: **Charles Eastham**, foreman, **W. L. Mastin**, lease foreman; Perry group: **C. R. Shepherd**, foreman.

Osage area: Barnsdall, Oklahoma, **R. R. Rothrock**, field superintendent; Avant group: **A. R. Griggs**, lease foreman, Bartlesville group: **J. R. Brown**, lease foreman; Bigheart Pershing group: **Edgar Olsen**, lease foreman; Delaware Flatrock group: **Clyde Smoot**, lease foreman; Wildhorse group: **E. D. Fritz**, lease foreman.

WYOMING GROUP: Thermopolis, Wyo., **C. A. Daugherity**, foreman.

NORTHWEST NEW MEXICO GROUP: Aztec, N. M., **Gene Heath**, foreman.

•

SHELL OIL COMPANY is now issuing an identification card to its employes entering the armed forces. The card will serve to introduce the employes to company officials throughout the world, as an aid to familiarizing the employe with foreign lands.

•

POWELL DRILLING COMPANY has acquired the rotary drilling tools formerly operated by Powell & Peters Drilling Company, Inc., of Great Bend, Kansas. Offices for Powell have been established at 306 Derby Building, Wichita. **Charles M. Powell, Jr.**, son of **C. M. (Sam) Powell**, senior partner, has resigned from his position with Sohio Petroleum Company at Oklahoma City and will be associated with the new company as junior partner. **Melvin Kiefer** will continue to supervise drilling operations from Great Bend.

•

SUNRAY OIL CORPORATION has acquired 825 developed acres in the North Ochelata field, Osage County, Oklahoma, and will turn the 46 producing wells on the lease into a proposed waterflood project encompassing more than 1000 acres. The wells acquired by Sunray adjoin offset acreage to the north on which Sunray currently has a pilot waterflood project in operation and the company proposes to combine the properties into a single waterflood program.


MAKE THE RIGHT MOVE

INSIST ON ALTEN SURFACE EQUIPMENT

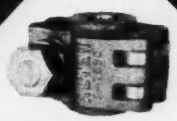
LUBRICATED STUFFING BOX

STUBBY TUBING HEAD

CLOVERLEAF STUFFING BOX

Alten equipment gives you deluxe features at rock bottom prices.

STOP COCK



WONBOLT POLISHED ROD CLAMP

It costs Alten far more to build equipment so that it costs you far less to operate and maintain it.

THE WORLD'S BEST PUMPING UNIT

Longest Strokes
Highest Gear Reducer Ratings
plus
Hardest Gear Surfaces

ALTEN

Pumping Units, Tubing Heads, Stuffing Boxes — every piece of equipment in the broad Alten line is fully performance proved. Get more for your money from the smallest Polished Rod Clamp to the largest Pumping Unit by asking your dealer to furnish Alten equipment.

ASK FOR COMPLETE ALTEN LINE
AT YOUR LOCAL SUPPLY STORE

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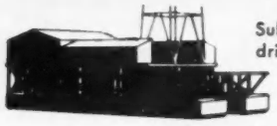
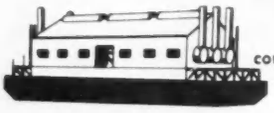
Levingston

BUILDS FINE SPECIALIZED MARINE EQUIPMENT FOR THE PETROLEUM INDUSTRY



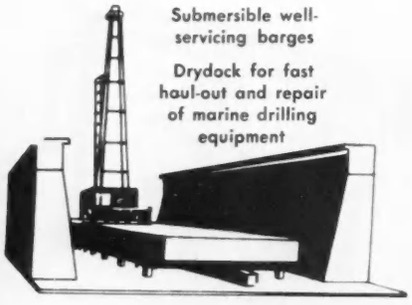
Submersible drill barges

Tugs



Boiler and compressor barges

Water, oil, and supply barges



Submersible well-servicing barges

Drydock for fast haul-out and repair of marine drilling equipment

Levingston is not only located conveniently with respect to marine drilling operations on the Gulf Coast, but here you will find marine engineers and constructors who understand the language of oil operators. Bring your marine petroleum equipment problems to Levingston *first* for a quick economical solution.

Levingston

SHIPBUILDING CO.

Orange, Texas

## *Special Trains Will Take Delegates to API Meet*

Special rail transportation has been arranged for the Texas contingent of oil industry representatives who will attend the American Petroleum Institute's annual meeting at Chicago's Palmer House and Stevens Hotel November 5-8.

Santa Fe Railway Company has scheduled an 18-car special train from Houston, including 13 Pullman cars, two lounge cars, two diners, and one dormitory car. This train will leave Houston at 7 p.m. November 3 and arrive in Chicago at 8 p.m. November 4. Returning, it will leave Chicago at 3 p.m. November 8 and reach Houston at 4 p.m. November 9.

Santa Fe's Texas Chief, a regular Houston-Chicago streamliner, leaves at 8 p.m. daily and arrives in Chicago at 9 p.m. the following day. Reservations for space on this train have poured in from those who plan to leave early for committee meetings.

Another special Santa Fe streamliner has been scheduled out of Tulsa. The train will include nine sleepers, an observation car, two lounge cars, and two diners. It will leave Tulsa at 5 p.m. November 4 and arrive at Chicago at 8 a.m. November 5. On the return trip, the special will leave at 4:30 p.m. November 8, arriving at Tulsa 7:30 a. m. November 9.

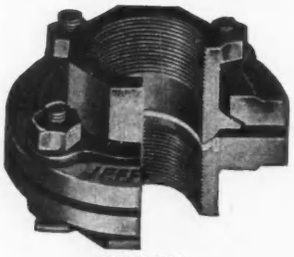
C & S Air Lines, Inc., has two regular Houston-Chicago flights daily each made by a 57-passenger Constellation. One leaves at 8 a.m., arriving in Chicago at 1:15 p.m. after landings at Memphis and St. Louis. Breakfast and luncheon are served aloft. The second flight leaves at 3 p.m. daily and arrives at 7:15 p.m. after a landing at St. Louis. On this flight, dinner is served.

For return flights, C & S has three planes leaving daily for Houston: At 9:30 a.m., 2:30 p.m. and 4:45 p.m. These flights reach Houston at 1:46 p.m., 9:5[illegible] p.m. and 9:57 p.m., respectively.

Three daily Braniff International Airways flights also serve Houston and Dallas. Braniff's "Million-Aire" leaves Houston at 7:30 a.m., stops in Dallas and Kansas City, and arrives at Chicago at 12:55 p.m. "El Conquistador" leaves Houston at 10:40 a.m., stops in Dallas, and arrives in Chicago at 3:20 p.m. The "Texan-Aire" leaves at 4:40 p.m., and arrives in Chicago at 9:20 p.m., after a stop at Dallas.

Three Braniff flights to Chicago leave Oklahoma City daily: At 1:35 p.m., 5:25 p.m., and 2:40 a.m. These planes arrive at Chicago at 6 p.m., 9:50 p.m., and at 7:10 a.m., respectively.

Jefferson Malleable Unions



STYLE "B"

JEFFERSON Style "B" three-piece flange union is made with brass-to-iron and iron-to-iron seats. Being made of highly refined AIR FURNACE iron. it assures you of lightweight construction, perfect ball joint, and positive seating arrangement, whether or not in alignment.

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HYDRAULIC PRESSURE RATING

| Sizes | Test Pres. | O. W. G. | S. W. P.-550 Deg. |
|---|---|---|---|
| ½" thru 4" | 2000# | 800# | 250# |
| 5" and 6" | 1200# | 500# | 250# |
| 8" and 10" | 1000# | 400# | 250# |

Malleable iron used in all JEFFERSON unions meets ASTM 4733, Grade 35018—M. T. 53000 Lbs., giving 75% more elongation 50%-more impact value and is 30%-stronger than cupola malleable iron.

Obtainable through your jobber

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Lexington, Mass.

# MACK TRUCKS

# See You Through

• There are many good reasons why a Mack is your best truck investment during times like the present. Most important of all is the undisputed fact that Mack trucks outlast them all.

This means that with a Mack truck you can face the uncertainties of the future with assurance...confident that even if trucks should become hard to replace your Mack will see you through...that it will stay on the job delivering dependable service mile after mile and year after year.

Thousands of truck users in World War II found out by actual experience that they were indeed "Lucky to own a Mack." Whatever the future may bring, you'll find that for a sound investment in long-term reliability and operating economy there's no other truck to match a Mack.

Your nearest Mack branch or distributor will give you the full story on what "Built Like A Mack" means in *extra* long life, *extra* strength and stamina, *extra* performance and *extra* dependability.

Mack TRUCKS

***...outlast them all***

Mack Trucks, Empire State Building, New York 1, N.Y. Factories at Allentown, Pa.; Plainfield, N. J.; Long Island City, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

**Loaded with a 30-ton draw works, this big Mack six-wheeler is "seeing things through" for Stephens & Stephens, oil field haulers of Graham, Texas.**

## Staples Succeeds Cranson as Head of Oil Producers Group

D. T. Staples has been elected president of Oil Producers Agency of California, succeeding L. A. Cranson, executive vice president of Honolulu Oil Corporation, who has served the agency as president for the past three years.

R. M. Blodget, who has been executive vice president of the agency since its founding in 1932, was re-elected. Other re-elected officers are H. E. Woodworth, Safe Oil Company, Bakersfield, first vice president; R. A. Grant, Fullerton Oil Company, Pasadena, second vice president; W. H. Geis, petroleum engineer, Los Angeles, third vice president; C. A. Johnson, Holly Oil Company, Los Angeles, fourth vice president; and Stark Fox, Oil Producers Agency, Los Angeles, vice president; W. A. Russell, Seaboard Oil Company, secretary-treasurer; and Verne Harrell, Bankline Oil Company, Los Angeles, assistant secretary-treasurer.

Staples is executive vice president and a director of Pacific Western Oil Corporation, vice president and director of Mission Corporation, and of Mission Development Company, and a director of Getty Realty Corporation. He has been a director of Oil Producers Agency for many years.

W. Alton Jones

L. S. Wescoat

## National Leaders to Address Texas Mid-Continent Sessions

W. Alton Jones, president of Cities Service Company and API chairman, and L. S. Wescoat, president of The Pure Oil Company, are among the oil industry notables and ranking government officials who will address the Texas Mid-Continent Oil & Gas Association's 32nd Annual Meeting in Beaumont, Texas, October 8-9.

Jones, who will address the opening session, during World War II was president of War Emergency Pipelines, Inc., the organization that built the "Big Inch" and "Little Big Inch" pipe lines. He has been president of Cities Service since 1940 and chairman of the API since 1948.

A director of the API and a member of the National Petroleum Council, Wescoat is a veteran of 25 years in the oil industry. Before joining Pure in 1925 he was in the automotive and public utilities fields. He has been a director of Pure since 1936.

## API Announces Schedule for Spring Production Meetings

District spring meetings of the API Division of Production will be held at the following times and places:

**Southwestern District:** March 5-7, Washington-Youree Hotel, Shreveport; Olin G. Bell, Humble Oil & Refining Company, Houston, chairman.

**Mid-Continent District:** March 19-21, Broadview Hotel, Wichita, Kansas; Harold Berg, Tide Water Associated Oil Company, Tulsa, chairman.

**Eastern District:** April 2-4, William Penn Hotel, Pittsburgh; E. T. Heck, Minard Run Oil Company, Bradford, Penn., chairman.

**Rocky Mountain District:** April 24-25, Gladstone Hotel, Casper, Wyo.; C. H. Griffin, Phillips Petroleum Company, Casper, chairman.

**Pacific Coast District:** May 15-16, Biltmore Hotel, Los Angeles; Paul Andrews, Signal Oil & Gas Company, Los Angeles, chairman.

## Electrical Association Elects

A. L. Stegner, Tennessee Gas Transmission Company, Houston, has been elected president of the Petroleum Industry Electrical Association to serve during 1951-52. H. G. Pegues, United Gas Company, Shreveport, and W. H. Massey, Interstate Oil Pipe Line Company, Tulsa, were elected vice president and secretary-treasurer, respectively. M. C. Callahan, Gulf Oil Corporation, Tulsa, will be general chairman for the 1952 meeting of the association to be held in Tulsa.


**Eagle-Picher Lead Wool**

*Stops bottom water*

Prevent costly shutdowns, keep bottom water out of your wells, with effective, economical Eagle-Picher Lead Wool. The fine, flexible strands fill cracks and crevices with a permanent, non-corrosive seal . . . save you time and money. Packed in convenient 50-pound sacks — easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.

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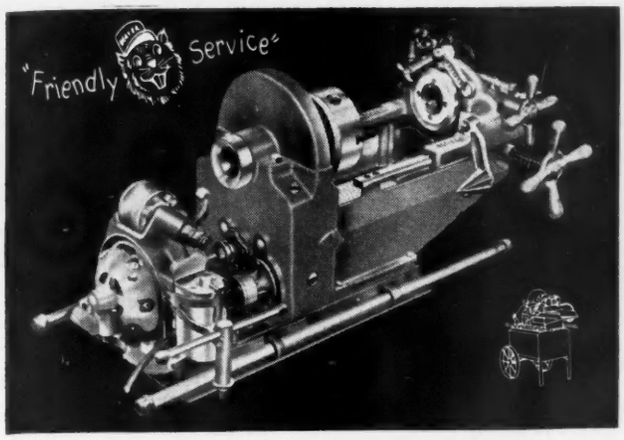
*These* **3** *Eagle-Picher Bearing Metals meet most requirements*

1. **Dreadnaught** — for extreme speed and heavy-duty conditions.
2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

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BEAVER PIPE TOOLS

WARREN, OHIO, U. S. A.
252-300 DANA AVE.

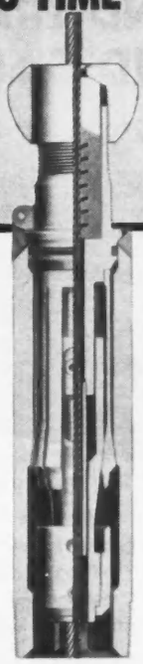
Performance is what counts in a pipe machine . . . and, successful performance is always news . . . year after year.

Beaver Model-A Pipe and Bolt machine gives you quick, clean threads, precision cutting and reaming. It is right handed with all controls in front. You get 50% greater working space, gear driven power in abundance, and a full range from ⅛ to 2 inches.

Reversible Universal motor, safety "shear pin," rack and pinion feed, self-centering wheel and roller cut-off, heavy duty chuck, adjustable opening die heads, interchangeable die segments and an easily accessible oil pump . . . all add up to **top performance.**

For more information on successful pipe tool operation . . . write for catalog on the BEAVER line today.

# REDUCE
## BAILING and SWABBING TIME *with the* BOWEN AUTOMATIC LINE WIPER



**THE BOWEN AUTOMATIC LINE WIPER** is an inexpensive tool that will quickly "pay out" its cost by increasing efficiency and reducing time spent on bailing or swabbing work. With this completely automatic unit you can . . .

**. . . KEEP THE WIRE LINE CLEAN**
**. . . PREVENT GAS AND FLUID LEAKAGE**
**. . . MAINTAIN A DRY and SAFE RIG FLOOR**

No special attention is required for operation. When pulling out, the packer seals off tightly around the wire line, keeping gas and fluid inside the casing—not on the rig floor. **AND NO AMOUNT OF PRESSURE CAN BLOW IT OUT!** Yet, when struck by the outcoming rope socket, it releases instantly and rides out on top, relocking in the body automatically when the tools are lowered again. No unlocking . . . no resetting . . . and no need to "flag" the line.

**The Bowen Line Wiper is available in sizes for all commonly used drill pipe and tubing connections. Order yours today!**

SR BOWEN CO

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# Make FORD POWER your PROFIT-POWER!

**YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED**

● Now, more than ever, Ford Industrial Engines and Power Units mean "profit-power" for your equipment. That's because Ford Power is *right* three big profit-making ways:

***1. Right Power***—five great models from 120 cu. in. displacement to 337 cu. in. displacement. Every unit is individually tested, ready to run.

***2. Right Features***—when you standardize on Ford Power you have readily available a complete line of special Ford equipment, mobile components and accessories to handle economically and effectively any operating condition.

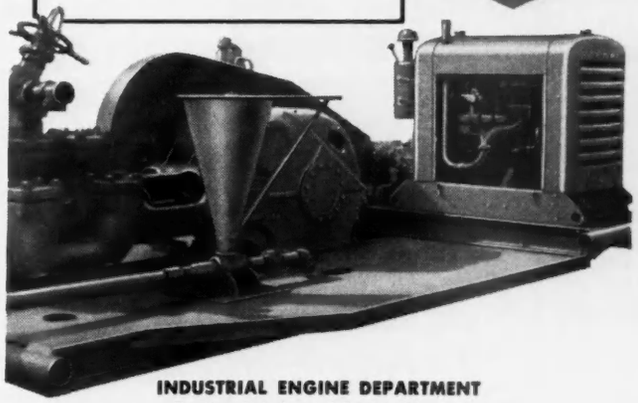
***3. Right Service***—with Ford Power you are assured of efficient, accessible service, as near as the nearest Ford Dealer.

**HERE ARE SOME TYPICAL FORD-POWERED OIL INDUSTRY APPLICATIONS:**

**Hoists and Winches**
**Pipe Line Forming Machines . . . Welders**
**Well Cementers . . . Drill Rigs . . . and many others**

Ford INDUSTRIAL ENGINES AND POWER UNITS

**The Wilson-Snyder Mud Pump,** familiar sight in oil fields, is powered with the Ford "254" 6-cylinder Power Unit for rugged, dependable performance.



**INDUSTRIAL ENGINE DEPARTMENT**
*Tractor & Industrial Engine Division*
**FORD MOTOR COMPANY**
**Highland Park, Michigan**

**Industrial Engine Department, FORD MOTOR COMPANY**
**15050 Woodward Ave., Highland Park 3, Michigan**

I am interested in Industrial Power for:_____
*(state your application)*

Send me new 1951 literature on Ford Industrial Power Units.
☐ "120" 4-Cyl. ☐ "226" 6-Cyl. ☐ "239" V-8 ☐ "254" 6-Cyl. ☐ "337" V-8

Firm Name_____
*(Please print)*

Attention of_____

Street_____

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PARELEX
Electric Heaters
for
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Bottom Hole Tubing and Flowline Heaters for Paraffin and Heavy Crude
Write for Details
Model BH3
PARELEX CORPORATION
P. O. Box 552
HOUSTON 1, TEXAS

# ASSOCIATIONS

## Oil Progress Week Will Be Observed Throughout Nation

The oil industry's fourth observance of Oil Progress Week, October 14-20, will be the biggest in its history.

Community leader-oil men luncheons and dinners, exhibits and parades will invite public attention to the industry, its achievements and its continuing progress. Also planned are "Oil Men for a Day" events, essay contests, and radio and television interviews.

In Salt Lake City, Utah, T. S. Petersen, president of Standard Oil Company of California, will address a meeting of oil men, civic leaders and one high school senior from each of the 40 school districts of the state. The students will tour a refinery and an oil field.

Other top executives scheduled for community leader or other luncheon and dinner speaking engagements during Oil Progress Week include: H. S. M. Burns, president of Shell Oil Company, at the large New York City luncheon on October 16; P. C. Spencer, president of Sinclair Oil Company, before a luncheon group in Chicago; Robert E. Wilson, chairman of the board, Standard Oil Company (Indiana), at the Boston Conference of Distribution and also at a luncheon sponsored by the New Orleans Chamber of Commerce; L. S. Wescoat, president of The Pure Oil Company, at a large dinner at Minneapolis; B. I. Graves, Tide Water Associated Oil Company, at a Newark, N. J., luncheon; Frank M. Porter, API president, at a large Houston community event; Charles L. Harding, in charge of Middle East operations, Socony-Vacuum Oil Company, before a group in Boston; K. S. Adams, chairman of the board, Phillips Petroleum Corporation, and Mrs. Marie Drake Carver, granddaughter of Colonel Edwin L. Drake, who will speak in Kansas City.

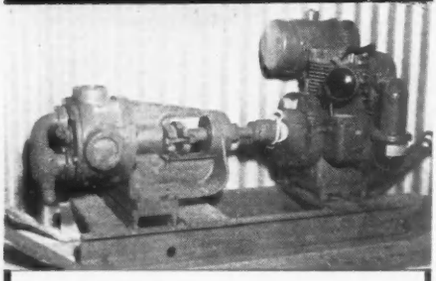
## Water-Flood Specialist Named Penn Grade Committee Member

J. Kenneth Barton, chief engineer in charge of water-flooding for Quaker State Oil Refining Corporation's production department at Bradford, Pa., has been appointed a member of the Pennsylvania Grade Crude Oil Association's production research technical advisory committee.

Barton discovered and developed the so-called slug treatment of oil properties with sodium hypochlorite and has helped pioneer the use of amine-type chemicals for treatment of water injected under high pressures into oil formations.

Starting in the oil fields as a pumper and roustabout, he became lease foreman for Forest Oil Corporation. Later he did scouting, engineering and geological work for the firm in Pennsylvania, Illinois, Ohio and West Virginia. When Forest sold its New York and Pennsylvania properties to Quaker State, Barton was assigned to engineering problems in secondary recovery.

for Low Moving Cost, specify
LMC CIRCULATING Pump

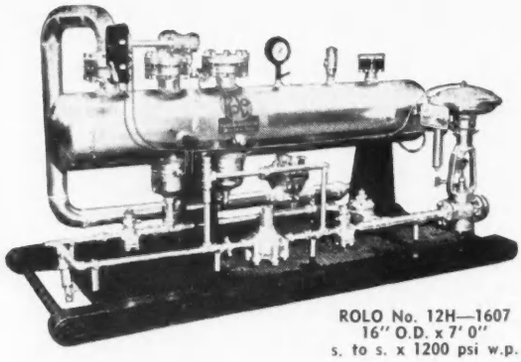


DIRECT DRIVE with BUILT-IN SPEED REDUCER

There's an LMC Circulating Pump to save you money on every move from well to consumer. Low initial cost with practically no upkeep cost, plus longer life, mean real economy with an LMC Pump.

LMC
LUBBOCK MACHINE CO., INC., LUBBOCK, TEXAS

ROLO WELLCHECKERS
SKID AND TRAILER MOUNTED
OIL AND GAS SEPARATORS



ROLO No. 12H—1607
16" O.D. x 7' 0"
s. to s. x 1200 psi w.p.

Made in all sizes and working pressures to suit any operation, Rolo Wellcheckers enable the operator to check his individual well production daily, weekly, monthly, or as required. Used in making drill stem tests, potential tests, periodic production tests, gas-oil ratio tests, marginal well tests, etc. Shipped completely piped and ready to operate. Write for illustrated Bulletin No. 1951-W or see Composite Catalog.

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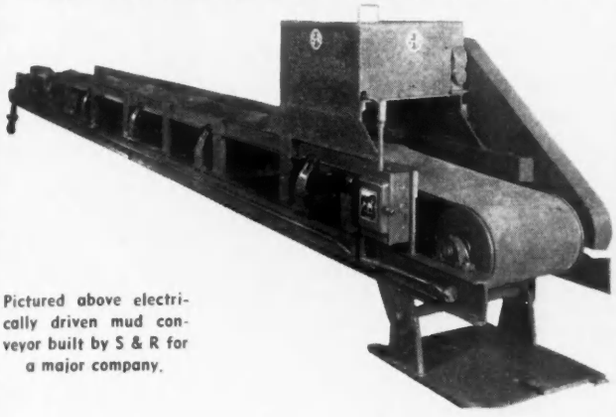
ROLO MANUFACTURING COMPANY
2510 South Blvd., Houston 6, Texas
BRANCHES: Corpus Christi, Midland, Kilgore, Tulsa, New Orleans, Los Angeles, Casper, Calgary, (Alta.)
EXPORT OFFICE: R. S. Stokvis & Sons, Inc., 17 Battery Place, New York, N. Y.

## S & R SPECIAL *Custom Built* MUD CONVEYORS FOR DRILLING BARGES



Pictured above electrically driven mud conveyor built by S & R for a major company.

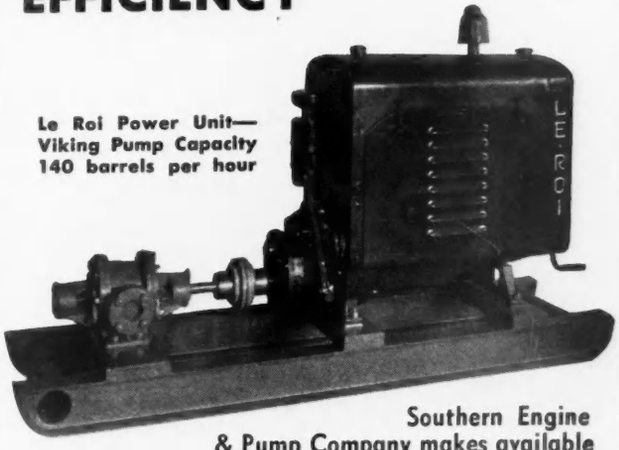
Here's the answer to efficient movement of mud for your drilling barge—it's S & R's custom built electrically powered, chain drive mud conveyor.

Built for heavy duty service with quality materials equipped with reversible belt, troughing idlers, protected easily accessible drive housing. Operates efficiently all positions to 35° off horizontal. Built in sizes to 40 feet.

*Write, wire or phone for additional information*

**S & R TOOL & SUPPLY CO.**
P. O. Box 1755 155 McCarty
HOUSTON 1, TEXAS
*Export:* 233 Broadway, N. Y. 7, N. Y.

## THE RIGHT TEAM FOR EFFICIENCY



Le Roi Power Unit—
Viking Pump Capacity
140 barrels per hour

Southern Engine & Pump Company makes available to you 40 years of "KNOW HOW" in your pumping requirements.

- Complete units and replacement parts at all branches.

**SOUTHERN ENGINE & PUMP COMPANY**

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS
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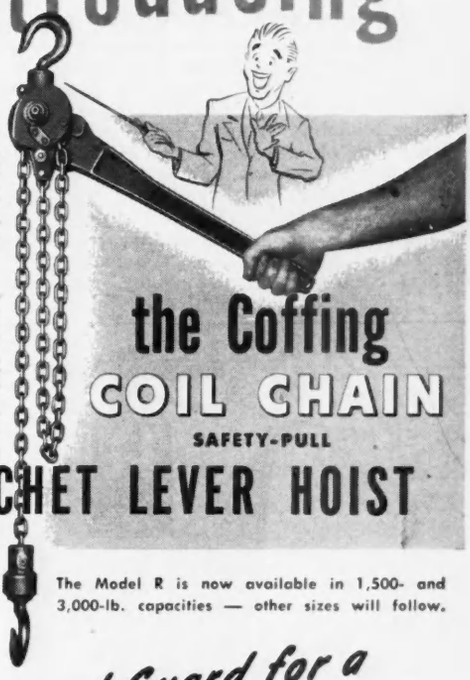
Corpus Christi, Texas• Houma and Lafayette, La.

## introducing



## the Coffing COIL CHAIN SAFETY-PULL RATCHET LEVER HOIST

The Model R is now available in 1,500- and 3,000-lb. capacities — other sizes will follow.

## *Advanced Guard for a New, Advanced Line*

**Here is a completely new ratchet lever hoist designed to bring you added safety and convenience. The Model R incorporates the time-proved ratchet and pawl principle originated by Coffing — makes it hold positively at all times — no friction-type brake to slip or freeze — chain is free wheeling when not under load.**

### *Many New Advantages*

**COIL CHAIN** Swings or wraps in any direction for greater flexibility in use.

**SIX OPERATING POSITIONS** Handle operates in any position, works on full or partial strokes — for ease of handling in close quarters. Safety stops prevent spinning of handle.

**SAFETY FACTOR OF FIVE** All hoist load-holding parts designed to withstand pull equal to five times rated capacity. Each hoist also factory tested at 100 percent overload. "Safety-valve" handle bends at point of maximum safe overload.

**SIMPLE TO SERVICE** The Model R may be completely disassembled with only a screwdriver for easy servicing. Not necessary to return it to the factory for repairs.

Find out more about the hoist that gives you greater convenience and safety in all lifting, pulling, stretching. Write for bulletin 010R

**COFFING HOIST COMPANY**
**Danville, Illinois**

Quik-Lift Electric Hoists • Hoist-Alls • Mighty-Midget Pullers
Spur-Geared Hoists • Differential Chain Hoists • Load Binders
I-Beam Trolleys

*Sold by Industrial Distributors everywhere*

## Tulsa Engineers Club Names Baroid Engineer as President

Jack H. Beesley, division sales manager, Baroid Sales Division, National Lead Company, has been elected president of the Engineers Club of Tulsa, succeeding Lloyd E. Elkins, Stanolind Oil and Gas Company.

Other new officers are W. L. Horner, chief petroleum engineer, Sunray Oil Corporation, executive vice president; William R. Clarke, machinery sales engineer, Jones & Laughlin Supply Company, treasurer; Harold R. Meyer, district manager, DeLaval Steam Turbine Company, vice president in charge of programs; LeRoy T. Bossard, supervisor of mechanical engineering, Stanolind, vice president in charge of membership; J. E. Byers, office manager, Black, Sivalls & Bryson, Inc., vice president in charge of entertainment; Wright Canfield, vice president Public Service Company of Oklahoma, vice president in charge of public relations.

Elkins automatically becomes a director to serve along with two electees, W. F. Hildebrand, sales engineer, General Electric Company and Dale G. Savage, Service Pipe Line Company. H. T. (Jack) Frost, continues as executive secretary.

★ For working pressures from 1500 to 3000 lbs.
★ All parts interchangeable
★ Bean is quickly and easily replaced
★ Easily converted to positive choke
O-C-T THREADED ADJUSTABLE CHOKES GIVE YOU
Four Star Flexibility
The O-C-T Type "N" Adjustable Choke has earned its reputation as the most popular choke in the field by outstanding, dependable performance. In combination with O-C-T Flow Tees, this choke can be used to make proration tests by simply backing off the yoke nut and inserting the proper size O-C-T FC-140 positive bean or O-C-T FC-141 insert cage bean. Ask your O-C-T representative or write for complete mechanical details on the O-C-T Choke that gives you four star flexibility. Available through your supply store.
Oil Center Tool Co.
P. O. Box 3091, Houston, Texas
O-C-T HAS PIONEERED HIGH PRESSURE CONTROLS

## Rocky Mountain API Production Group Elects Griffin Chairman

C. H. Griffin, Phillips Petroleum Company, Casper, Wyo., was elected chairman of the Rocky Mountain District, API Division of Production. He succeeds C. L. Larson, Jr., Stanolind Oil and Gas Company.

Regional vice chairmen are Paul Kartzke, Shell Oil Company, Casper, at large; Fred Clement, Continental Oil Company, Denver, for Colorado; A. E. Campbell, Seaboard Oil Company, Casper, for Wyoming; and H. F. King, Continental Oil Company, Billings, Mont., for Montana.

Other new officers are James A. Hill, Oil Well Supply Company, Casper, secretary-treasurer; and C. L. Larson, Jr., chairman of the advisory committee. New members of the advisory committee are R. S. Shannon, Jr., Pioneer Oil Company, Denver; B. F. Hanley, Reed Roller Bit Company, Casper; Gilbert Mueller, Argo Oil Corporation, Denver; Lee Kelton, Black, Sivalls & Bryson, Inc., Casper; J. L. Dougan, Equity Oil Corporation, Salt Lake City; J. G. Dyer, Dyer Drilling Company, Denver; W. T. Nightingale, Mountain Fuel Supply Company, Rock Springs, Wyo.; T. T. Freeman, The Texas Company, Denver; A. P. Lacey, Continental Supply Company, Casper; and R. L. Manning, Fred M. Manning, Inc., Denver.

## AIME Petroleum Branch Meets October 3-5 in Oklahoma City

Approximately 800 people are expected to register for the Petroleum Branch meeting the the American Institute of Mining and Metallurgical Engineers in Oklahoma City October 3-5.

Plans for the meeting have been carried out by committees under the direction of Dean A. McGee, general arrangements chairman. Other committee chairmen are R. M. Caywood, finance and entertainment; J. C. Cordell, hotel arrangements; W. M. Edinger, registration; L. F. Elkins, meeting arrangements; A. E. Sweeney, Jr., publicity. Mrs. L. F. Elkins is chairman of the Ladies' Activities Committee.

Technical sessions during the three-day conference will discuss field case histories, reservoir engineering, production operations, drilling technology, water flooding, drilling and well completion, gas technology and production research.

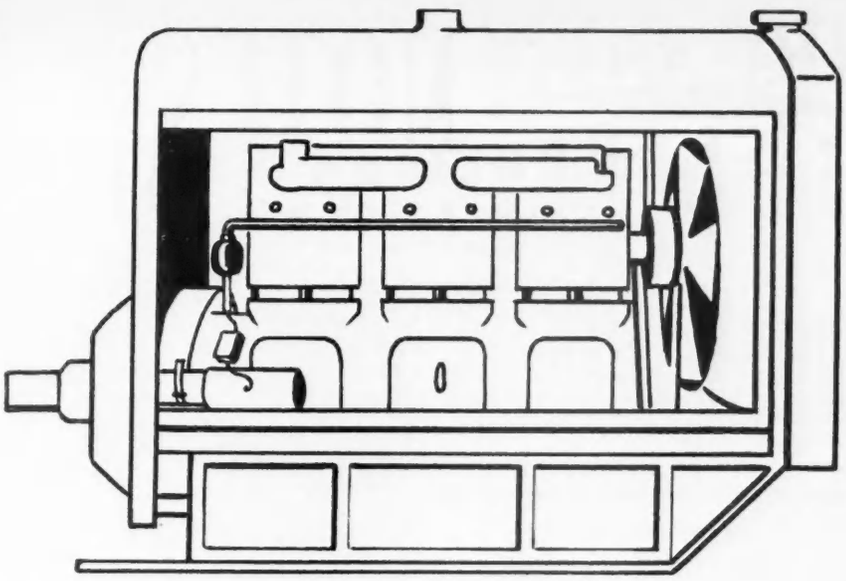
## First Engineering Geologist Degree is Conferred by LSU

The first professional degree of engineering geologist ever awarded was conferred at Louisiana State University to Alvin James Bourgeois of Baton Rouge. The new curriculum was established two years ago at the request of oil companies.

Bourgeois has been employed by Shell Oil Company at Houston in the Geophysics department. After thorough orientation, he will eventually go into the interdepartmental liaison work for which he has been trained.

## Wilson Heads Geologists

Louis R. Wilson, geologist for The Carter Oil Company, has been elected president of the Oklahoma City Geological Society, succeeding Dick Roberts, Vickers Petroleum Company.



**will a p-8 substitute for a z-10?**

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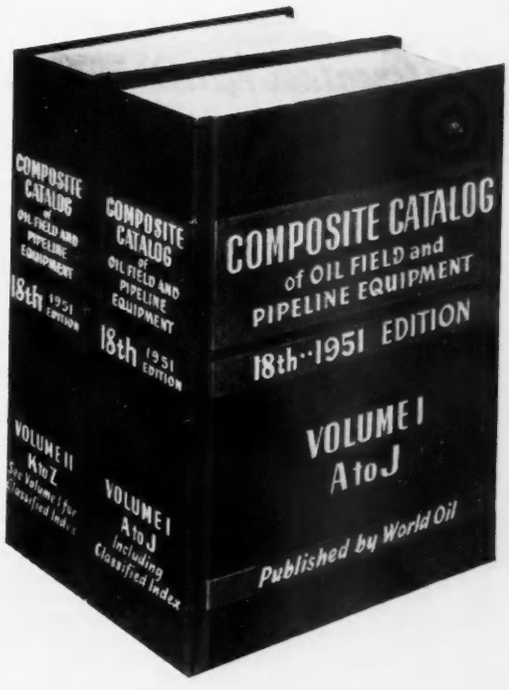
You will find the answer to this and many other questions about gasoline engines made by 19 manufacturers in COMPOSITE CATALOG.

Oil country buyers around the world reach for COMPOSITE CATALOG whenever they buy or specify gasoline engines — and more than 2900 other types of oil field and pipeline equipment. These buyers regard COMPOSITE CATALOG as one of the most used tools in the trade. Having the catalogs of 490 leading manufacturers available for instant use, indexed and cross-indexed throughout by company and product makes their buying job easier. Save time, save money, and eliminate errors in ordering — look it up in COMPOSITE CATALOG.




# COMPOSITE CATALOG

**DESCRIPTIONS OF NEW EQUIPMENT IN THIS ISSUE OF WORLD OIL ARE SUPPLEMENTS TO THE MANUFACTURERS' PRE-FILED CATALOGS IN THE COMPOSITE CATALOG**

# EQUIPMENT AND SERVICE SUPPLIERS' NOTES

### *Schlumberger Well Surveying Makes Several Field Organization Changes*

H. W. True, former district manager in Houston for Schlumberger Well Surveying Corporation, has been transferred to Jackson, Miss., as manager of the Mississippi division. He replaces F. P. Kokesh, who transferred to the Engineering department in Houston.

H. W. True

W. J. Lytle has been appointed manager of the Permian Basin division. He replaces A. Morazzani who recently transferred to Indiana as manager of the company's Northeast area.

R. L. Morris is transferring to Houston from Lafayette, La., to become administrative assistant to J. de Menil, president of the Affiliated South American Schlumberger Companies.

W. W. Goode will replace Morris as division manager of the Louisiana Gulf Coast division in Lafayette.

Lytle, Morris and Kokesh are all longtime members of the Schlumberger organization. All three were employed in 1937 and have worked in many oil provinces in the U. S.

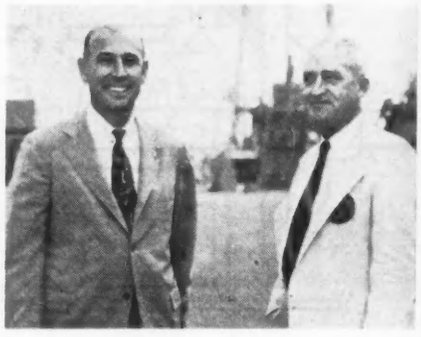
True and Goode were employed by the company in 1946. Their activity to date has been confined to the Gulf Coast area of Texas and Louisiana.

### *Baroid Sales Establishes Midland Office and Service Headquarters*

New service headquarters and field offices have been opened in the McClintic Building, Midland, Texas, by Baroid Sales Division, National Lead Company. Heading the new office is J. J. Edwards, assistant manager of the Mid-Continent division in charge of West Texas, New Mexico, North Central Texas and the Panhandle.

Also at Midland are D. D. Varnell, Mid-Continent division assistant sales manager, and S. E. (Tex) Wiginton, district superintendent for West Texas and New Mexico.

S. E. Geffen, Baroid district superintendent for North Texas and the Permian Basin, will be in charge of Baroid well logging service in the area.



Ben Hilliard, sales manager for the Oil Tool Division, Byron Jackson Company, left, and John Godfrey, Venezuelan representative of Petroleum Industry Consultants, C. A.

### *Petroleum Industry Consultants Are Byron Jackson Agents in Venezuela*

Byron Jackson Company is now being represented in Venezuela by Petroleum Industry Consultants, C. A., who will handle BJ oil tools and Patterson-Ballagh molded rubber products. John Godfrey of PICCA formerly worked for Creole Petroleum Company. He recently visited the main plant of Byron Jackson Company in Los Angeles to familiarize himself with the BJ line.

### *Oklahoma Representative is Named By Baird Manufacturing Company*

E. E. Spicer

Baird Manufacturing Company, Tulsa, has appointed E. E. (Spike) Spicer at Oklahoma sales representative for all Baird products. Spicer was formerly with the Diesel division of General Motors Corporation in Tulsa. With Baird he will work on promotion and sale of Baird oil field production equipment.

### *Barrett-Cravens, Crescent Truck Merge Materials Handling Firms*

Barrett-Cravens Company announced its merger with the Crescent Truck Company, Lebanon, Penn., manufacturers of electric industrial trucks and tractors. The Crescent Truck Company will be operated as a division of Barrett-Cravens.

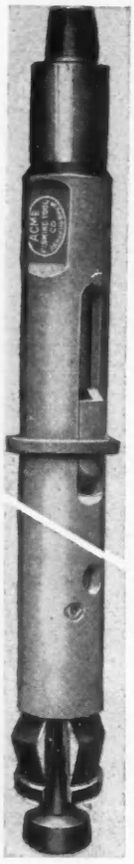
All sales will be conducted from the general office of Barrett-Cravens Company at 4609 South Western Boulevard, Chicago. Engineering and manufacturing operations will be continued at Lebanon. No major changes in personnel are contemplated.

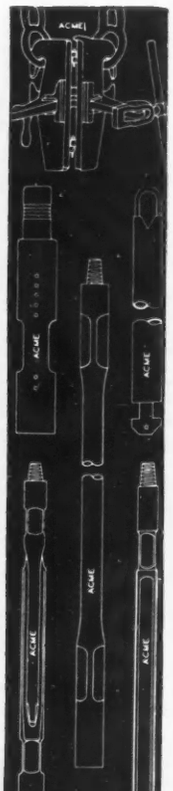

"The Greatest Name in Cable Tools..."

Acme

TRUSTWORTHY SINCE 1900

PETROLEUM EQUIPMENT SUPPLIERS' ASSOCIATION MEMBER





. . . to-be-Sure—Always Ask for Acme's Underreamer . . .

Acme's Underreamer increases hole size below casing, to lower casing and shut off water or cave-in. Reams faster. Avoids key-seating. Rounds out flat hole. Acme's exclusive 3-cutter unit assures advantages over 2-cutter types. Unique construction assures solid backing while reaming. Cone seats firmly around cutters, inside. Better cutting gauge. Keeps out dirt.

Cutters collapse (see cut) for "free and easy" in-and-out of hole. Expand for underreaming. No jarring into casing. No broken cutters. Body 1-SOLID forging. Hard surfaced cutting edges. All parts PREMIUM-grade steel; correctly heat-treated and precision machined, for maximum service.

See Acme's Insert in 1951 Composite Catalog. Also write for more complete Catalog, containing valuable cable tool "use and care" manual.

Fig. 142 — Acme 3-cutter Underreamer: 51-years' specialized "know-how" makes it worth more to YOU.

ACME DRILLING & FISHING TOOLS

ACME FISHING TOOL CO.
PARKERSBURG W. VA.
Export Office:
19 Rector St., New York 6, N.Y.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Continental Geophysical Company Will Offer New Seismograph Service*

Continental Geophysical Company has completed its organizational plans and is in active operation, A. E. (Sandy) McKay, president, announced Offices are at 6100 Camp Bowie Boulevard, Fort Worth. The company will furnish seismograph crews, act as consultants on exploration problems and engage in reanalysis of geophysical data.

A. E. McKay

McKay, a graduate of Oklahoma University, was assistant chief geophysicist for The Atlantic Refining Company. In June, 1950, he became executive vice president of Southern Geophysical Company.

### *Manufacturing, Sales Appointments Are Announced by Oil Well Supply*

Leo W. Bosch, Jr., has been named manager of quality control for Oil Well Supply Company's manufacturing operations. In other "Oilwell" appointments, Lee Fabj was made district merchandise manager in the South Louisiana-Mississippi district, and A. O. Thrasher was named manager of the Seminole, Okla., store.

Bosch will be responsible for establishing inspection and quality control standards at plants. He has been superintendent of inspection and quality control at Imperial Works, Oil City, Penn., since he joined the company in May, 1949. He will continue to maintain headquarters at Oil City.

Fabj will headquarter at the Harvey, La., store, and will supervise the stocking and administrative activities in connection with store operations in the district, whose headquarters are in New Orleans. He joined the company in 1943, and has most recently served in the production planning and procurement department at the Dallas home offices.

Thrasher has been a field representative at Seminole since joining "Oilwell" in February, 1949.

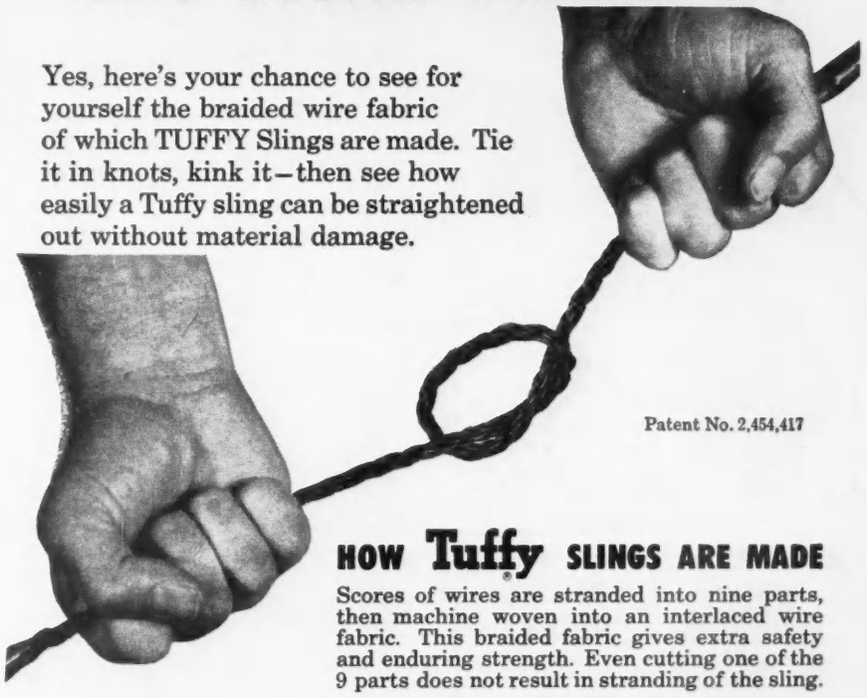
James E. Goff, who joined Oil Well Supply Company in February, 1938, as a clerk in the Centralia, Ill., store, has returned to that store as manager. All of Goff's service with "Oilwell" has been in the Illinois district. Since August, 1947, he has served as a storeman in the Salem, Ill., store, and prior to that he was located at Olney, Ill., and Chicago.

### *Patent Attorney Opens Office*

Lester B. Clark, patent lawyer specializing in oil field equipment, has opened new offices at 1108 State National Building, Houston. With him is associated B. R. (Bill) Pravel. Clark was formerly with the law firm of Andrews, Kurth, Campbell & Bradley.


# GET A FREE Tuffy® SLING AND PROVE TO YOURSELF IT'S MORE FLEXIBLE!

Yes, here's your chance to see for yourself the braided wire fabric of which TUFFY Slings are made. Tie it in knots, kink it—then see how easily a Tuffy sling can be straightened out without material damage.



Patent No. 2,454,417

**HOW Tuffy® SLINGS ARE MADE**

Scores of wires are stranded into nine parts, then machine woven into an interlaced wire fabric. This braided fabric gives extra safety and enduring strength. Even cutting one of the 9 parts does not result in stranding of the sling.

**11 TYPES—PROOF TESTED FOR SAFETY** There are 11 different types of Tuffy Slings, each one proof-tested to *twice* its safe working load. And the safe working load is plainly marked on metal tags on each sling. Also, Union Wire Rope engineers will help work out special sling problems. If you have your own rigging loft, Tuffy braided wire fabric is available by the reel.

**FREE SAMPLE—MAIL COUPON**

To show you the difference between TUFFY Braided Wire Slings and ordinary wire rope slings, we have made up a quantity of 3-foot slings. We want you to have one so that you can test it and prove to yourself that TUFFY Slings really are better. Mail the coupon below today for yours.

UNION WIRE ROPE CORP

More scrap means more steel turn yours in today!

**UNION WIRE ROPE CORPORATION**
Specialists in Wire Rope, Braided Wire Fabric and High Carbon Wire
2104 Manchester Ave. Kansas City 3, Mo.

*Gentlemen: Please have my Union Wire Rope fieldman deliver me a FREE Tuffy Sling.*

Name_____

Address_____

City_____ Zone____ State_____

Firm Name_____

Catawissa
PERFECT SEAL
Unions

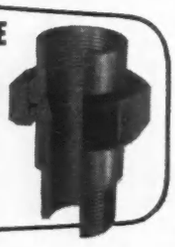
HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes 1/8" to 3"; 6000-lb. sizes 1/8" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

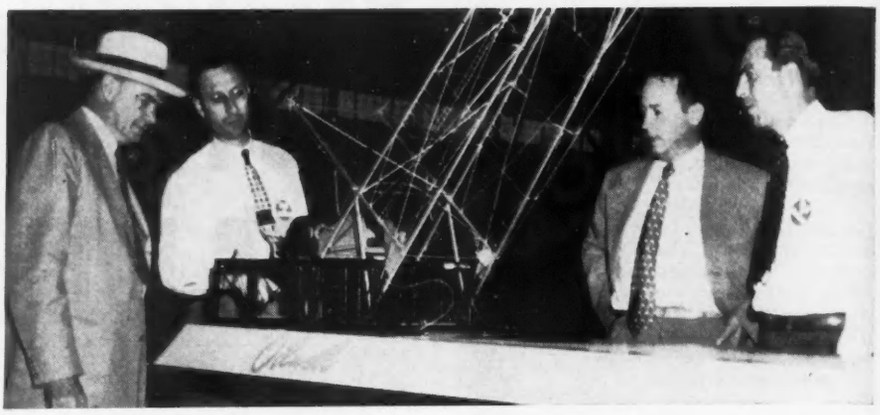
MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.



Standard & Double Extra Heavy
LUG NUT UNIONS
Hammer-type for quick opening and quick closing.

Stocked and Distributed by
OIL WELL SUPPLY CO.
Branches Serving All Oil Fields
CATAWISSA VALVE AND FITTINGS COMPANY
60 Mill St. • CATAWISSA, PA.


## EQUIPMENT and SERVICE SUPPLIERS' NOTES



**Looking On** as Alex Quayle, second from left, chief engineer for Oil Well Supply Company, demonstrates a mechanical scale model of a new "Oilwell" portable steel derrick are D. V. Carter, left, chief petroleum engineer for Magnolia Petroleum Company, John W. Wagner, Texas Mid-Continent Oil & Gas Association, and John E. Miller, "Oilwell's" manager of machinery service. The picture was taken during "Oilwell's" recent open house at its new warehouse and modification center at Garland, Texas.

### *Oil Tool Representative Assigned By Byron Jackson to Houston Area*

Max T. Sutton

Max T. Sutton has been appointed service engineer in the Houston office of Byron Jackson Company's Oil Tool division. Sutton served 4½ years with the Army Air Force. He was formerly employed by Humble Oil & Refining Company, and has had field experience in drilling and production.

### *Torrey and Cushman Establish Firm To Handle Surface Active Chemicals*

Paul D. Torrey and Allerton Cushman have formed a general partnership known as Oil Recovery Chemicals, with offices and laboratory at 705 Lamar Boulevard, Austin, Texas.

The new firm is the exclusive representative of Armour and Company of Chicago for the sale and application of surface active compounds and other chemical products used in production of oil and gas and for other related operations of the petroleum industry in Arkansas, Louisiana, New Mexico, Oklahoma and Texas. It is also special representative of Oil Recovery Corporation, New York, for application of the Orco Process (carbonic acid process) to certain reservoirs to increase oil recovery.

### *Whitney Moves West Coast Quarters*

Whitney Chain Company has moved its district sales offices to new and larger quarters at 70 Dorman Avenue, San Francisco. The office, under the direction of George F. Haag, district manager, will function as the engineering sales outlet for the complete line of Whitney power transmission and conveying chain, couplings and sprockets in the San Francisco and Northern California regions.

### *Petross and Parrish Join Oil Base As Sales Engineers in West Texas*

W. H. (Pete) Petross and Harlan Parrish, sales engineers, have been added to the field staff of Oil Base, Inc., and will

W. H. Petross

Harlan Parrish

be stationed in West Texas, with Petross headquartered at Odessa, and Parrish at Midland, Texas.

Petross was formerly co-owner of Walker Oil Well Specialties, Inc., in Oklahoma City, and prior to that had been district manager for Hinderliter Tool Company in the Rocky Mountain area.

Parrish, a graduate of Oklahoma City University, was analytical chemist for Oklahoma Testing Laboratory, and more recently was with Santa Fe Drilling Company.

### *Pelton Oil Machinery is Available From New West Texas Installation*

Pelton Long Stroke Hydraulic Pumping Jacks are now available at Odessa, Texas, C. J. Woodard, manager of the Oil Industry Machinery division of Pelton Water Wheel Company, announced.

Complete parts and warehouse facilities are being maintained, under the management of Earl Dwyer, formerly Los Angeles plant office manager. Also at Odessa is Gene Bell, who has worked in West Texas fields for 15 years.

The Odessa installation is in the Texas Warehouse Building, 407 West Second Street.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

S. S. Hanley

W. H. Bendean

R. T. Nelson

J. D. Gilbride

### *Clark Bros. Company Establishes Sales-Service Office in Pittsburgh*

Clark Bros. Company, Inc., Olean, N. Y., has opened a new sales and service office in Pittsburgh, with Sidney S. Hanley in charge. Hanley has been worked with William H. Bendean out of the Orlean office for the past five years and is continuing with the company in a consulting capacity.

Also in the Pittsburgh office are James D. Gilbride, a Cornell graduate, and Robert T. Nelson, an R.I.T. graduate.

### *Merla Tool Names Sales Engineers For Oklahoma, Texas and Louisiana*

Robert R. Shackelford has been named district sales engineer for Oklahoma by Merla Tool Corporation, Dallas, manufacturer of gas lift equipment and accessories. Shackelford, a graduate of Oklahoma University, will headquarter in Oklahoma City. He was formerly with Welex Jet Services as field salesman in the Oklahoma area.

It was also announced that Robert C. Warren, Jr., has been appointed as sales engineer in the East Texas and North Louisiana area. Warren, a graduate of Texas A. & M. engineering school, will temporarily be headquartered in Shreveport. Before joining Merla he was with Continental Supply Company in the West Texas area.

### *Mid-Continent Supply Company Opens New Field Store in Mississippi*

Mid-Continent Supply Company has opened a new field supply store in Natchez, Miss., with F. A. Burge as manager. The new office, located at 102 Main Street, is under the supervision of the Mississippi, Louisiana, Arkansas division headed by division manager C. M. Fleeman.

G. H. Canterbury and A. M. Thompson are field salesmen and R. H. Wallace, Isaac Foster and J. B. Timmons are storemen.

**"Our PIPER'S a paying proposition"**

***Says G. D. Murray, Drilling Superintendent Big Chief Drilling Company, Shreveport, La.***

"Supervising rigs in East Texas, Louisiana and Mississippi keeps me on the go," says Mr. Murray. "I used to average 1200 miles a week by car which meant I spent most of my time driving.

"That's why I decided to fly. Took my first lesson last November and was amazed at how easy it was to learn. In the first six months I flew our company-owned Piper planes over 50,000 miles. Now I'm averaging better than 2000 miles a week in our new Piper Pacer and I've tripled the amount of time I can spend on the job at the rigs.

"The Pacer costs less to operate and maintain than a car and I'm averaging 135 miles per hour. Quite often I can land right beside a rig because the Pacer doesn't need much room. It would be hard to say how many times our Piper has paid for itself. It certainly is a paying proposition."

**ON THE GO ALL THE TIME—**
*that's the Big Chief Drilling Company's versatile Piper Pacer. For men or materials the Pacer provides speedy, economical transportation. At left G. D. Murray (white shirt) prepares to fly drilling personnel to an emergency job in southern Mississippi.*

Price-wise, performance-wide, Piper planes are ideally suited for many companies in the oil business. Piper planes cost little more than a fine car, are easy to fly and economical to operate. Why not investigate how your company can profit by using a Piper just as the Big Chief Drilling Company does. Your nearest Piper dealer will be glad to demonstrate the fine new Piper planes and explain the new Piper "Learn-as-you-Travel" plan. For colorful literature write Piper Aircraft Corporation, Lock Haven, Pa., Dept. L-10.

**PIPER** AIRCRAFT CORP., LOCK HAVEN, PA.

TUBE-KOTE PREVENTS COSTLY REMOVAL OPERATIONS

PARAFFIN DEPOSITION *Successfully Prevented* By TUBE-KOTE

Internal Coating of Tubing, Flow Lines, and Related Equipment Pays Off In Continuous Operation

IF YOU HAVEN'T USED TUBE-KOTE . . . TRY ONE WELL
*See How Effectively Tube-Kote Licks Paraffin!*

Paraffin removal operations can be *costly!* . . . But they can be prevented in many cases by the application of "TK-2" SPECIAL-KOTE, a thermo-setting (baked-on) plastic coating. Major oil companies have proved the economy of using Tube-Kote to solve this problem. Complete technical service reports available on request.

TUBE-KOTE TUBE-KOTE
*First Name In Corrosion Resistance*

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WIRE, PHONE OR WRITE FOR TUBE-KOTE TECHNICAL SERVICE BULLETIN

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

G. G. Wilbur

E. F. Shiels

### *Shiels, Wilbur and Duncan Advanced To Ideco Sales and Research Posts*

Ideco Division, Dresser Equipment Company, announced that E. F. (Gene) Shiels has been named domestic sales manager, succeeding Tom A. Ramey, resigned. Gordon G. Wilbur was named assistant export sales manager.

Ideco also announced the assignment of Dan Duncan as research engineer for the Oil Field division. Duncan has had 30 years' experience in the oil industry.

Shiels, an engineering graduate of Texas A.&M. College, joined Ideco as a sales engineer in 1946, and since 1949 has been technical service manager at Dallas.

Wilbur, a petroleum engineering graduate of Oklahoma University, has been with Ideco 12 years.

### *American Iron & Machine Appoints Division Manager of Four-State Area*

A. P. (Joe) Wells has been appointed division manager for Arkansas, Louisiana, Mississippi and East Texas for American Iron & Machine Works Company. His headquarters will be in Shreveport.

A. P. Wells

Wells, who attended Louisiana State University, spent five years for The National Supply Company as representative in Illinois, and five years for Oil Well Supply Company in the Rocky Mountain area. He joined the American Iron sales organization in 1949 as assistant district manager in the West Texas district.

### *Cleco Distributors Are Appointed*

The Cleco Division of Reed Roller Bit Company has appointed Elect Air Tool Company, 310 West Verdugo Avenue, Burbank, Calif., and W. E. Mushet Company, 795 Bryant Street, San Francisco, as distributors for Cleco products in their areas.

### *Continental Promotes Store Men*

George P. Daley, field salesman at Harvey, La., for Continental Supply Company, has been appointed store manager at the same location. Jack R. Barron, assistant store manager at Kilgore, Texas, has been named store manager at Palestine, Texas.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

R. P. Bloss

W. O. Cook

### *Cook Succeeds Bloss as Manager Of Ideco's Beaumont Facilities*

R. P. Bloss, general manager of the Beaumont manufacturing plant of Ideco Division, Dresser Equipment Company, has retired, but is being retained as an independent executive consultant.

William O. Cook, who has been Bloss' understudy and has been with Ideco 17 years, has been promoted to general manager.

Bloss was for several years chief engineer of Parkersburg Rig and Reel Company. He was appointed chief engineer of Ideco in 1921, and for many years before going to the Beaumont plant in 1936, was vice president and general manager of Ideco-Columbus (Ohio).

Cook, a mechanical engineering graduate of The Rice Institute, was appointed director of engineering for Ideco in 1940, and became assistant general manager at Beaumont in 1946.

### *Borg-Warner Elects H. G. Ingersoll As Vice President of Corporation*

Harold G. Ingersoll has been elected a vice president of Borg-Warner Corporation. He will also retain the presidency of the corporation's Ingersoll Steel Division at Newcastle, Ind., and is a member of the Borg-Warner board of directors.

He went to Newcastle in 1917 to become vice president and treasurer of the Indiana Rolling Mill Company, then owned by his father, the late Stephen A. Ingersoll. When the company was acquired by Borg-Warner Corporation in 1929 and became a part of the Ingersoll Steel Division, Ingersoll continued as vice president and general manager.

### *Pittsburgh Coke & Chemical Names Two Protective Coatings Officials*

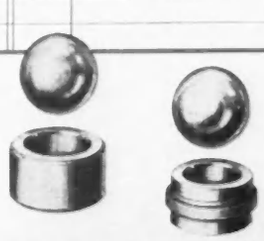
O. E. McCullough, Jr., and E. C. Vierling, Jr., has been appointed assistant managers of the Protective Coatings division of Pittsburgh Coke & Chemical Company, Pittsburgh. They will be responsible for directing and coordinating sales, production, technical service and development. McCullough will be associated with Tar Base coatings, and Vierling with Synthetic Base coatings.

McCullough formerly had his own oil business in Dallas, and prior to that was director of personnel and sales manager of Stacey-Dresser Engineering Company in Cleveland, Ohio, and established that company's branch office in Dallas.

Vierling was formerly with Howard Plastics and Monsanto Chemical Company, Plastics division, in sales.

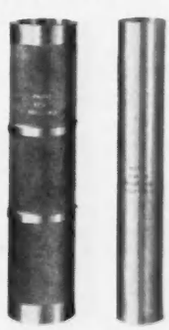
by Pacific PUMPS INC.

| | QUESTION | | ANSWER |
|---|---|---|---|
| Q | Why is oil at the bottom of the well like money in a safe deposit box? | A | Because it is a LIQUID ASSET IN DEAD STORAGE WITHOUT EARNING POWER. |
| Q | Can this condition be changed? | A | Yes — both can be activated and given earning power. |
| Q | How can they be activated? | A | Draw some of the money from the safe deposit box — purchase and install a Pacific Oil Well Plunger Pump in the well — pump the oil to the surface. MONEY IN CIRCULATION — OIL IN CIRCULATION — BOTH WITH POWER TO EARN. |
| Q | Why purchase and install Pacific Oil Well Plunger Pumps? | A | Because only Pacific gives you the EXCLUSIVE MOLOY® LINERS with the strength, toughness, hardness, combined with greater resistance to temperature, corrosion and abrasion essential for long, economical life. |



*Plungers — Chrome-Plated then Pacilited* for extra wear life.
*Valves and Seats* — To fit well conditions.
*Extra Heavy Seats* — Resist hammering of ball with less chance of distortion.

PACIFIC *Precision Built* PUMPS



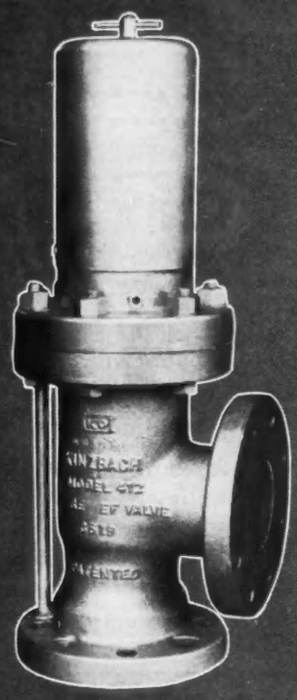
DW-6

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
*Export Office:* Chanin Bldg., 122 E. 42nd St., New York
*Offices in All Principal Cities*

*Instant Full-Open Relief of Excessive Pressures*

**KINZBACH**
**Model 412 Relief Valve**



Among the design features that have brought about the immediate acceptance of the Model 412 Valve with pipeline and refinery engineers everywhere is its ability to open instantaneously to full capacity when the pressure overload in the line is reached, thus providing maximum relief when it's most needed.

Other important features include Automatic Resetting, at a pre-determined pressure drop, Positive Seating, and facilities for Functional Testing.

Model 412 utilizes line pressure for opening and closing. Opening pressure is easily pre-set by the application of a dead-weight load. Action is positive and reliable—the pre-set pressure never changes.

For absolute safety and dependability, use them at strategic points on your hydraulic systems. Available in 2", 3", 4", 6" and 8" sizes, for working pressure up to 1000 p.s.i.

**KINZBACH TOOL COMPANY**
INCORPORATED

Write for Bulletin RV412 for full technical information.

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Export Office:
74 Trinity Pl.
New York, N. Y.

KINZBACH TOOL CO INC


## EQUIPMENT and SERVICE SUPPLIERS' NOTES

J. C. McCelvey

L. L. Durkin

### *McCelvey, Durkin, Rogers Assigned By Well Equipment Manufacturing*

Well Equipment Manufacturing Corporation has transferred J. C. McCelvey and L. L. Durkin to the New Mexico, West Texas territory as sales representatives, and has assigned Harry T. Rogers to the East Texas, North Louisiana and Southern Arkansas.

H. T. Rogers

McCelvey, who has been with the company 13 years, has been Weco sales representative on the Gulf Coast for the past three years. His new headquarters are in Odessa, Texas.

Durkin, who will make his headquarters in Hobbs, N. M., has been with the company two years.

Rogers was assigned to sales after a period of service in the Weco plant and upon completion of the training program.

### *Axelson Firm Advances Comptroller To Position of Company Treasurer*

Axelson Manufacturing Company has appointed J. M. McFadden to the office of treasurer of the company. First joining the Axelson organization in 1938, McFadden has served in the Accounting department and as assistant office manager. Upon the death of the company's former treasurer, O. W. Carlson, some months ago, McFadden assumed the duties of company comptroller.

J. M. McFadden

### *New Orleans Office is Established By Houston Oil Field Material Firm*

The Houston Oil Field Material Company, Inc., has opened offices in the Canal Bank Building, New Orleans. The new offices will be headquarters for Tom Holland, division manager of Homco services; T. F. Burke, district sales manager; and A. O. Meadows, assistant division sales manager.

Other Homco Louisiana headquarters will be at Harvey, Houma, New Iberia and Lake Charles.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

Marshall S. Cloyd

Clifton Blackmon

### *Dallas First National Advances Advertising-Public Relations Men*

Clifton Blackmon has been elected an assistant vice president of the First National Bank in Dallas to serve as director of advertising and public relations. Marshall S. Cloyd, vice president, who has served as advertising director of the bank, is receiving the added title of assistant trust officer and, to meet expanding requirements of the business development division of the Trust Department, will take over and supervise its program of specialized advertising and aid in its promotional work.

Since December, 1943 Blackmon has been director of publicity and advertising for the Dallas Chamber of Commerce and editor of its official publication, *Dallas* Magazine.

### *Continental Supply Company Names Dunaway Assistant Credit Manger*

A. A. Dunaway, has been appointed assistant credit manager for The Continental Supply Company. Dunaway, a graduate of Louisiana Tech, went to work for Continental in 1936 in sales at Shreveport. In 1941 and 1942 he worked in the Houston credit office. He was in the armed service from 1942 to 1945 and has since served as district credit manager at Fort Worth and Tulsa.

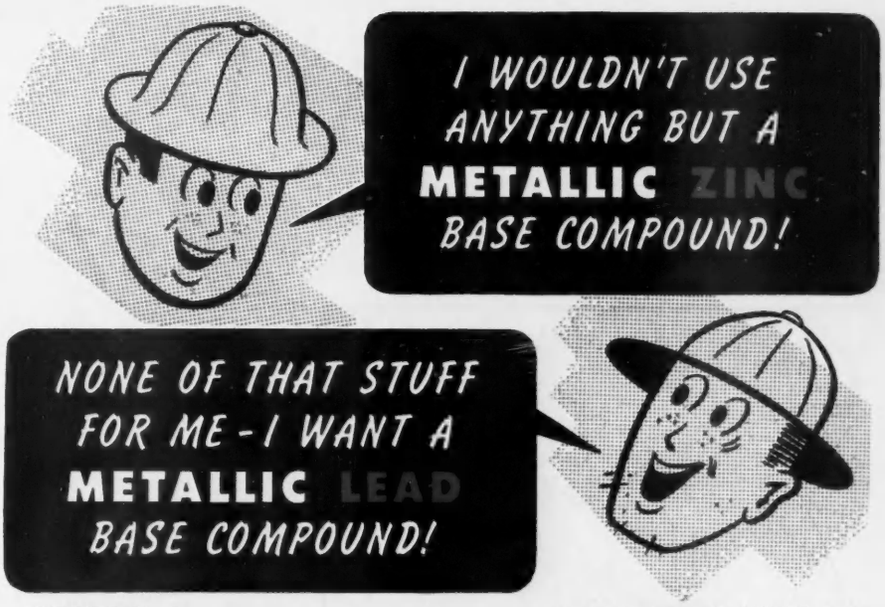
A. A. Dunaway

### *National Opens New Illinois Store*

The National Supply Company has opened a store in Robinson, Crawford County, Illinois. The new store, tenth for National Supply in Illinois, is under the management of Wayne A. Brown, transferred from the Crossville, Ill., store. Field representative is Pearl A. (Steamer) White, transferred from Lawrenceville, Ill.

### *United Supply Adds Ideco Line*

United Supply & Manufacturing Company has added the Ideco line of drilling rigs, and also stocks Ideco accessories. A service department for the equipment will be maintained at each United Supply store.


WECO has the best COMPOUND FOR BOTH OF YOU!

If you prefer a zinc base compound, you'll want NO-GALL, containing more than 50% PURE METALLIC ZINC, which exceeds tool joint manufacturers' specifications for this type of compound. It will give you maximum performance from your tool joints . . . will protect them against galling, freezing and thread friction. NO-GALL has no harmful fillers of any kind . . . will not squeeze out . . . will not harden . . . requires no thinner.

WECO STEEL-AID is what you need when you want a metallic lead base compound. It contains 67% PURE METALLIC LEAD . . . an even higher percentage than specified by tool joint manufacturers. Steel-Aid has no fillers or other harmful ingredients, is non-hardening, requires no thinner . . . will not squeeze out under extremely high torque or pressure . . . assures expected performance efficiency from tool joints.

*Everybody agrees on this about*
HI-SPEED SEAL

It's your best thread seal for casing, tubing, steam lines, oil and gas lines and others where leak-proof connections are essential. It seals with less torque . . . assures better make-up and faster break-out. Ask for WECO HI-SPEED SEAL . . . it requires no thinner.

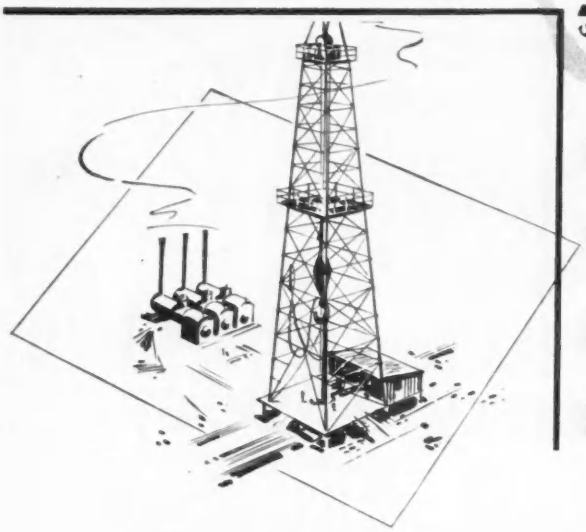
WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
HOUSTON 1, TEXAS
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea, Calif. Chicago 3, Ill. Newark 2, N. J.
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. Newark 2, N. J.

WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

A SALUTE FROM

BUILT ON SERVICE 1st SINCE 1866

TO TEXAS' FIRST INDUSTRY



Oil Progress Week, October 14 to 20, gives Americans an opportunity to recognize the achievements of one of the nation's vital industries.

And because Texas provides nearly half of the nation's crude oil and nearly a third of its refined products, Texans have an unusual interest in the progress of oil.

The First National is proud to have had a part in that progress . . . to have served the industry since its beginnings in Texas. We are happy to join in a salute to the entire industry, and particularly to those men who have made the words "Texas" and "oil" practically synonymous.

We invite them to make use of the complete banking facilities we have developed to serve them.

FIRST NATIONAL BANK

BUILT ON SERVICE 1st SINCE 1866 *in Houston*

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION


## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Sales Representative is Assigned To Houston Area for Nordstrom Valve*

F. J. Bradford

F. J. Bradford has been named special sales representative in the Houston district for Nordstrom valves, according to C. K. Madison, Houston district sales manager for Rockwell Manufacturing Company. Bradford has had 18 years' experience in selling oil field equipment in the Mid-Continent and Gulf Coast areas.

### *Lufkin Foundry & Machine Appoints Sargent to South American Position*

Ben C. Sargent

Lufkin Foundry & Machine Company has appointed Ben C. Sargent, Jr., as South American representative. Sargent spent two months in New York City working with A. V. Simonson, export manager. The new South American agent has had three years' training in the oil fields of Texas and Arkansas. He was previously a pilot in the Army Air Force.

### *Billings Will Head Pipe Line Sales For Thornhill-Craver at Houston*

Tom Billings

Tom Billings has been placed in charge of sales for the Pipe Line department of Thornhill-Craver Company. He has been a sales representative in the Houston territary since the first of the year.

Before joining Thornhill-Craver, Billings was a petroleum engineer with Gulf Oil Corporation. A native of Dallas, he is a graduate of the University of Texas petroleum engineering school. His headquarters will be in Houston.

### *Export Agent Tours Foreign Fields*

W. O. Calvert, export sales representative for Thornhill-Craver Company, Mission Manufacturing Company and A-1 Bit & Tool Company, all of Houston, is making an extended tour of oil fields in England, Holland, West Germany, France, Italy and the Middle East.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Otis Export Appoints Spalding as Canadian Sales and Service Engineer*

Jim G. Spalding

Jim G. Spalding, a University of Oklahoma petroleum engineer graduate, has joined Otis Pressure Control Export Corporation as sales and service engineer for Canada. He will be stationed at Otis' newly-established office in Calgary.

Spalding formerly was with Mene Grande Oil Company in Venezuela. After returning to the U. S. he spent several months working out of the Otis division offices in New Iberia and Odessa. One of his West Texas jobs included snubbing pipe under pressure in several helium wells in the Amarillo area. Spalding is a native Canadian.

### *Earle M. Jorgensen Names Bowman Mid-Continent Operations Manager*

Delmer Q. Bowman

Delmer Q. Bowman has been appointed manager of Mid-Continent operations for Earle M. Jorgensen Company, steel distributor, and will direct the firm's activities in the territory served by the Dallas and Houston plants.

Bowman, who is a vice president of Jorgensen, has served the past 12 years as salesman in the Mid-Continent, and as district manager in Houston.

### *Withers Is Appointed Sales Manger For Wheatley Distributing Concern*

James H. Withers

Charles Wheatley Company, Tulsa, has appointed James H. Withers as sales manager. Withers, who has been with Wheatley a year, was formerly with Manning, Maxwell & Moore, Inc. He had previously worked in San Francisco.

The Tulsa petroleum and industrial distributing company has offices in Bartlesville, Okla., Houston, Odessa, Oklahoma City and Shreveport.


Only genuine RIDGID guarantees economy

This Work-Saver RIDGID assures you..."No pipe wrench housing repair expense."

• You'll find no substitute for the smart-working long-lasting qualities that have made the RIDGID the world's most popular pipe wrench. Breakproof housing, full-floating hookjaw with handy pipe scale, replaceable heeljaw, adjusting nut that spins easily in all sizes, 6" to 60", comfort-grip handle —these plus the RIDGID name mean more service and tool satisfaction for your money. Buy at your Supply House.

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★ Work-Saver Pipe Tools ★

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# Wanta pump something at lower cost?

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| | | | |
|---|---|---|---|
| Air | Dye Solutions | Latex | Salt Water |
| Alcohol | Edible Oils | Mash | Shortening |
| Ammonia | Ethane | Methane | Sludge |
| Beer | Fish Oils | Milk | Soap |
| Benzol | Formaldehyde | Molasses | Sodium Chloride Solution |
| Boiler Feed Water | Fresh Water | Naptha | Sodium Silicate |
| Brewer's Mash | Gas, Manufactured | Nitric Acid | Sodium Sulfate Solution |
| Butter | Gas, Natural | Nitrogen | Starch |
| Butane | Gasoline | Oil, Crude | Sulphuric Acid |
| Cane Syrup | Glucose | Oil, Refined | Sump Water |
| Calcium Carbonate Slurry | Glue | Oxygen | Sweet Water |
| Calcium Sulfate Slurry | Glycerine | Paint | Tomato Juice |
| Casein Solutions | Glycols | Potassium Hydroxide | Varnish |
| Cement Slurry | Hydrochloric Acid | Propane | Vinegar |
| Chocolate | Hydrofluoric Acid | Raw Boiler Feed Water | Viscose |
| $CO_2$ Gas | Ink | River Water—Dredging Operations | Water (various) |
| Crude Oil | Jam | Rosin | Wax |
| Dairy Products | Jelly | | Whey |
| | Ketchup | | |
| | Lacquer | | |

THIS list of fluids will give you a rough idea of the diversity of pumping jobs in which Darcova Pumcups are responsible for really *big* savings.

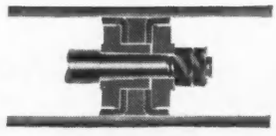
It boils down to the fact that Pumcups all but eliminate fluid slippage *throughout* their life span . . . and they *last many times as long as other packings.* Think of the down-time avoided, the production gains due to prolonged high efficiency, and the time-and-money-saving reduction in maintenance!

Years of application research have gone into the development of Pumcups. Made today in standard as well as many special compositions and textures for a wide range of temperature and pressure conditions, they offer you superior cost-cutting service in virtually *any* pumping job, simple or tough! And they're available in diameters from 1 to 20 inches.

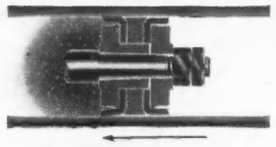
### SEND FOR FREE BULLETIN

Why not weigh *all* the facts? Bulletin 4401 covers Darcova Pumcups for reciprocating pumps; Bulletin 4502 on Pumcups for air or hydraulic mechanisms. Write for yours today.

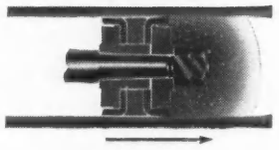
DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED



UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE



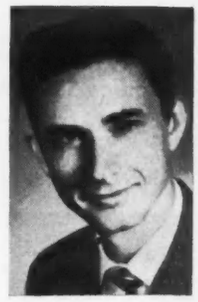
**DARLING VALVE & MANUFACTURING CO.**
WILLIAMSPORT 7, PA.

DARCOVA ® TRADE MARK
THE ORIGINAL COMPOSITION CUP

**PUMCUPS**


## EQUIPMENT and SERVICE SUPPLIERS' NOTES

Wayne L. Moore



A. B. Sanders

### *Technical Oil Tool Adds Two New Service Engineers in Mid-Continent*

Technical Oil Tool Corporation, Ltd., has added two new service engineers in the Mid-Continent area. Totco has stationed Wayne L. Moore in the Houston area, and A. B. (Al) Sanders has joined the Odessa, Texas, staff. Six engineers now work under R. L. O'Rear, Gulf Coast division manager, and eight under F. E. Siever in the West Texas division.

### *Executive Appointments Announced By A. O. Smith in Two Districts*

Alfred E. Treen has been appointed manager of personnel and purchasing at the Houston Works of A. O. Smith Corporation, succeeding F. B. Dunn, resigned.

John B. Madden has been appointed

A. E. Treen

J. B. Madden

hydraulic sales manager for the North Central district, Chicago.

Treen has been with the personnel administration staff since November, 1946, and has participated in forming and administering the company's over-all personnel policies.

Madden, former product supervisor, originally operated hydraulic sales from the Houston Works.

### *Welex Jet Services Will Offer New Radioactivity Well Surveying Method*

Welex Jet Services, Inc., Fort Worth, has entered into a license agreement with Well Surveys, Inc., Tulsa, to conduct radioactivity well surveying operations under WSI patents. Welex is the second service company to be licensed by Well Surveys, Inc., to operate in the U. S.

The Welex logging trucks and equipment are now in process of being assembled. At present Welex is rendering jet perforating services for both casing perforating and open hole shooting. Date when radioactivity well logging services will be available from Welex in the field has not been announced.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *American Hoist Elects Carroll Vice President in Charge of Sales*

John E. Carroll, general sales manager of American Hoist and Derrick Company, has been elected vice president of sales.

J. E. Carroll

Carroll, a graduate engineer from the University of Minnesota, joined American Hoist in 1937 as a district representative, and traveled successively in Texas, Chicago and West Coast territories. He resigned in 1945 to become a partner in the firm of Harron, Rickard & McCone Company of Southern California, managing the construction machinery division.

Carroll rejoined American Hoist as general sales manager in 1949.


**STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946**

OF WORLD OIL, published monthly at Houston, Texas, for October 1, 1951.

State of Texas, County of Harris, ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of WORLD OIL and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ray L. Dudley, 3371 Chevy Chase, Houston, Texas; Editor, Warren L. Baker, 1631 Woodhead, Houston, Texas; Managing Editor, Albert B. Reese, Jr., 4029 Gulf, Houston, Texas; Business Manager, A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; June Wooden Bliss, Houston, Texas; June Wooden Dudley Bliss, Trustee for Miss Fredrica Lucinda Dudley, Houston, Texas; A. L. Burns, Houston, Texas; James F. Carter, Jr. (Deceased), Tulsa, Oklahoma; Margaret D. Cashman, Houston, Texas; Carolyn Dodson Dudley, San Angelo, Texas; P. Stinson Dudley, Hebbronville, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Freeport, Texas; Libbie Rice Farish, Houston, Texas; Wm. V. Gross, Utopia, Texas; Mrs. Anita S. Lane, Houston, Texas; Charles H. Lane, Houston, Texas; James William Nelson, Baytown, Texas; Tom W. Nelson, Houston, Texas; J. Kent Ridley (Deceased), Houston, Texas; Walter Gage Sterling, Trustee for Mrs. Maud G. Sterling, Houston, Texas; O. R. Waller, Chicago, Illinois; Patricia McFarland Windham, Austin, Texas.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) M. D. Anderson Foundation, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS, Business Manager.

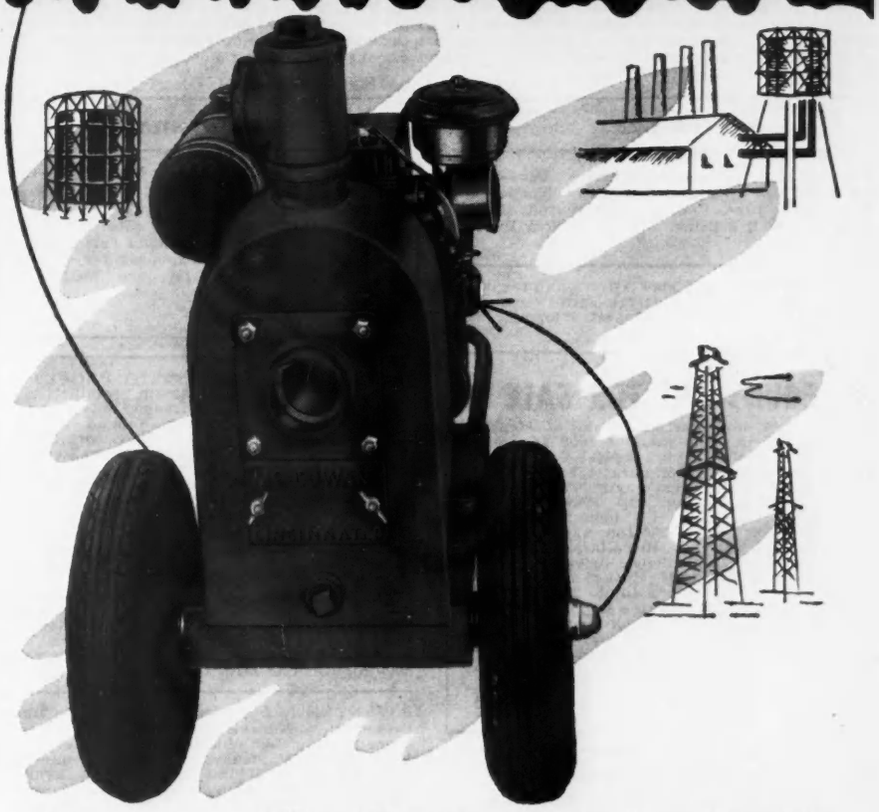
Sworn to and subscribed before me this 9th day of August, 1951.

P. J. AUCOIN.

(Seal) Notary Public in and for Harris County, Texas. (My commission expires June 1, 1953.)



BEST for OIL FIELD JOBS



McGOWAN

SELF-PRIMING CENTRIFUGAL OIL PUMPS

McGOWAN PUMPS are in operation in Oil Fields all over the world — backed by the reputation and integrity of a Company that has been building Pumps since 1852. McGOWAN PUMPS are unequalled for ruggedness, durability and the ability to do the job — BETTER — MORE ECONOMICALLY.

They feature AUTOMATIC PRIMING — SYNTHETIC RUBBER GASKETS AND SEALS — LARGE ACCESS PLATES. Can be furnished with electric or belt drive.

McGOWAN PUMPS are available at your Supply Co. Complete information can be furnished by writing or calling McGowan Pump Co., Central Ave., Cincinnati, Ohio.

SINCE 1852 McGOWAN PUMPS

McGOWAN

LEYMAN MANUFACTURING CORP.

PUMPS

58 CENTRAL AVE., CINCINNATI 2, OHIO

McGOWAN PUMP DIV., Leyman Mfg. Corp.
58 Central Ave., Cincinnati 2, Ohio
Please send without obligation data on McGowan self priming centrifugal pumps.

COMPANY_____

NAME_____

ADDRESS_____

# WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

**RATES:** Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

## FOR SALE

■ Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.

■ FOR SALE—Large size Alten pumping unit, single reduction gears, driven with Continental Motor. Good condition. Robert Murphy, Burgoon, Ohio.

### EQUIPMENT FOR SALE

All or any unitized item of steam drilling rig. Has made 1-8000 ft. well only. National type 34, 8½-FE oil bath drawworks. Parkersburg 136 ft. derrick, 12″ x 12″ Ideal engine, 2-20″ Wilson-Snyder Pumps. Oil Well 350-ton companion block, B-J 4300 Super-Triplex hook, Gray 500-ton swivel, 4¼″ and 5¼″ Kellys, drill collars, complete boiler feed unit, direct driven Dreadnaught coring unit, direct driven National M-8 20½″ rotary, 2 Cameron 13⅝″ Q.R.C. preventers with all accessories for complete hook-up and lesser equipment to complete rig. All equipment is in strictly first class condition. Call or write Oilfield Salvage Co., Inc., P. O. Box 2589, Houston, Texas, Telephone CHarter 6914.

**TITANIUM GEMSTONES**

CAN SUPPLY the sensationally beautiful synthetic Titania gemstones, the only thing on earth more brilliant and lively than the diamond; and at a small fraction the cost. Please that little lady with one of these marvelous gems. Ask for folder.

**C. C. BOAK, Tonopah, Nevada**

5150 acres of fine cotton and maize land for sale, located in Dawson County, Texas, about 12 miles southwest of Lamesa, and all in cultivation. The Sunray recently completed a small well on and near the northeast corner of this land. It is all leased for oil and/or gas to major oil companies or large independent oil companies, except approximately 55 acres, which is unleased. Will sell the land and ¼ royalty; or the land without any mineral interests; or ¼ royalty, either term or perpetual and either participating or non-participating. Correspondence invited, and brokers protected.

W. J. CLAY,
701 W. T. Waggoner Bldg.,
Fort Worth, Texas.

■ FOR SALE: Used oil barges, excellent for conversion to drilling and material barges. Write Commercial Petroleum & Transport Co., 344 Esperson Building, Houston 2, Texas.

■ LIKE NEW. 1—K8 International with tandem float; 1—1950 Chevrolet with pole trailer; 1—1949 Chevrolet with pole trailer; 1—GMC with pole trailer. All of the above are mounted with winches & beds and are in A-1 condition, ready to work. See or call: Myrel Eidson, 913 S. 24th St., Mt. Vernon, Ill. Phone 2072-W or 2159-J or 3617.

## HELP WANTED

■ WANTED—Branch Manager—Sales Manager and Salesman by distributor of engines and pumps in Texas. Address: Box 26W, c/o WORLD OIL, Houston, Texas.

## HELP WANTED

**GEOPHYSICAL FOREIGN SUPERVISOR, COMBINED GRAVITY AND MAGNETIC CREWS.** Top salary. Ideal living conditions. Subsistence furnished. Transportation and expenses for family. Address: Box 24W, c/o WORLD OIL, Houston, Texas.

LECTURER OR ASSISTANT PROFESSOR to teach petroleum production engineering in a southern university. Rank and salary will depend upon qualifications. Complete laboratory and library facilities. Housing ample. Reply by letter giving personal data, education, experience, and military obligation. Enclose personal photograph. Indicate salary expected. Box 27-W, c/o WORLD OIL, Houston, Texas.

## BUSINESS OPPORTUNITIES

■ WANTED TO BUY: An Oil Corporation that has "lost its shirt" the last two years. Wire or phone us collect. Must be a corporation. Goodall Electric Mfg. Co., Ogallala, Nebraska.

■ WANTED to buy from owner, producing oil property, preferably 1200 bbls per day or more from either shallow or deep horizon or both. In reply please state daily production, number of producing wells, total average, potential and other essential information. Box 28-W, WORLD OIL, Houston, Texas.

## SITUATION WANTED

**Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.**

## OIL AND GAS

In Western North Dakota and Northwestern South Dakota, I have a well selected spread of oil and gas leases, all of them running for approximately a ten year period. Correspondence invited, and brokers protected.

W. J. CLAY,
701 W. T. Waggoner Bldg.,
Fort Worth, Texas

■ PRODUCTION FOR SALE: 48 acre oil lease, 4 wells producing, two pay sections of Strawn Oil Sand 1500 ft. and 1600 ft., new field, last well completed Aug. 20th, 1951, potential 31½ bbls. per day of 40 gravity oil. Five or more proven locations to drill. For quick sale price $100,000. O. B. Klein, P. O. Box 464, Taylor, Texas, Phone 307.

■ Will act as your buying agent for oil and gas leases and royalties, in the Mid-Continent and Southeastern States fields. C. W. DEMING, Oil Lands Consultant, P. O. Box 1874, Tulsa, Okla., Box 320 Waycross, Ga.

## DECALS

TRUCK LETTERING AND TRADEMARK decals made for your trucks. Easy to apply, uniform, distinctive, economical for small or large needs. Write for Catalog. Mathews Company, 827 S. Harvey, Oak Park, Ill.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Oil Well Supply Company Promotes Keim to Division Chief Engineer*

Oil Well Supply Company has promoted Charles J. Keim to division chief engineer at Imperial Works, Oil City, Penn., principal manufacturing division. Keim will supervise all product design at Imperial Works, including that associated with drawworks, drives, rotary tables, swivels, traveling and crown blocks, automatic drilling controls, sucker rods, and pumping units.

Charles J. Keim

Charles L. Mohnkern, a design engineer at Imperial Works, has been promoted to engineer in charge of drawworks design, succeeding Keim.

Keim is a graduate of Lehigh University, where he received a B. S. degree in mechanical engineering in 1935. He joined "Oilwell" that year as a student engineer. After training at Imperial Works and at Wilson-Snyder division, Braddock, Penn., he spent the next several years in the engineering department at the Dallas home offices and later at Imperial Works. He was appointed a design engineer at the Oil City plant in October, 1943, and was promoted to engineer in charge of drawworks design there early in 1948.

Mohnkern, who has long experience in the Imperial Works engineering department, is nearing 30 years of service with "Oilwell," all at Oil City. He was employed at the plant in August, 1920, as a pattern maker. He served as a draftsman from 1930 to 1943, and in May of the latter year he became a design engineer.

### *Dowell Incorporated Now Offers Perfo-Jet Service in Midland Area*

Perforating service employing a new development, the glass gun, is now available in the West Texas and New Mexico area, Ralph Smith, district manager for Dowell Incorporated in Midland, Texas, announced.

The glass gun is a self-destroying gun which allows the use of a large explosive charge, and is effective in both casing perforating and open hole shooting. It consists of glass-enclosed, shaped charges in an expendable aluminum carrier. Charges are held in the carrier by thin steel bands. A detonating string-explosive, Primacord, is contained in each of the supporting aluminum tubes. Triangular aluminum guides control the gun diameter, provide strength and rigidity, and protect the glass cases while the gun is being run in the well.

The Midland district is the seventh in which Dowell Perfo-Jet Service is available.

**FOR RENT**

P & H Model 955 ALC Combination Crane, Dragline & Clamshell; 90′ boom; New 1950; A-1 condition. Usona Construction Company, 314 North Broadway, Telephone Central 3314, St. Louis 2, Missouri.

# New Books, Maps and Movies

## Northeast Texas Oil and Gas

Essential data on oil and gas occurrence in northeast Texas are given in a new reference book compiled from data gathered by the East Texas Geological Society and the Bureau of Economic Geology.

The 463-page book includes descriptions of 135 fields in 42 northeast Texas counties, with structure maps, graphic sections of rocks penetrated, and cross sections given for most of the fields.

Each description also gives the field's location, history, details of oil and gas occurrences in reservoir rocks, stratigraphic and lithologic details of rocks, nature of traps, productive area information on character of oil and gas recovered, and production history.

In addition to being one of the most complete compilations ever made of information on oil fields in a given area, "Occurrence of Oil and Gas in Northeast Texas" is a source of fundamental facts on oil and gas occurrence generally. The information can be used as a basis for research in exploration, Dr. John T. Lonsdale, University Bureau of Economic Geology director, said.

Bureau Research Scientist Frank A. Herald edited the data compiled in two years of research.

Bureau of Economic Geology, University Station, Box B, Austin 12, Texas. $10.

## Percentage Depletion

"Oil—Key to Progress and Security," a 16-page booklet, points out how the percentage depletion law contributes to the adequacy of the U. S. petroleum supply. Importance of petroleum in all phases and at all levels of American life is pictorially presented, and the case for continuation of the depletion allowance is effectively stated.

Independent Petroleum Association of America, Information Service, 1110 Ring Building, Washington, D. C.; and P. O. Box 1019, Tulsa. Free.

## Secondary Recovery

One of the most complete works on secondary recovery practices and procedures may be found in the Proceedings for the Second Oil Recovery Conference on the subject "A Symposium on Carbonate Reservoirs," published by the Texas Petroleum Research Committee, a joint project sponsored by the Texas Railroad Commission, The University of Texas and A. & M. College of Texas. The 206-page bound volume contains a wide variety of data on secondary recovery, including some new and suggested techniques for improving the recovery of oil. Fifteen technical papers by some of the nation's outstanding authorities on the subject are included.

Director, Texas Petroleum Research Committee, Texas A. & M. College, College Station, Texas. Free.

## Pipe Line Map

Alec Crowell's "Natural Gas Pipe Line Map," has been revised to July, 1951. The 21 x 30-inch map is printed in four colors.

Bell Transportation Company, P. O. Box 8598, Houston 9, Texas.

## Gas Industry

Composite income statements and balance sheets in dollars for the entire gas utility and pipe line industry for the years 1937-1950 inclusive are available in the new edition of "Gas Facts."

All data relating to gas sales have been restated in therms, rather than cubic feet. Included also are salient statistics relating to the Canadian gas industry.

American Gas Association, Bureau of Statistics, 420 Lexington Avenue, New York 17. $1.

## Central Texas Geology

A symposium for the 1951 field trip sponsored by the East Texas Geological Society, "The Woodbine and Adjacent Strata of the Waco Area of Central Texas" consists of nine papers on the area. Frank E. Lozo, geologist for Shell Oil Company, Houston, edited the papers, assisted by Bob F. Perkins. The book is illustrated with photographs, cross-sections and maps.

University Press in Dallas, Southern Methodist University, Dallas. $7.50 for cloth bound; $6.25 for paper.

DATE
WELL NO.
PUMPER'S SIGNATURE
REMARKS
#3 WELL MAKES EXCESSIVE WATER — Hot salt water in this well has caused composition ring and cup plungers to swell and stick due to lack of lubrication. We have had frequent pulling jobs to redress or replace these plungers, and also several rod jobs due to stuck plungers. Considering its allowable, this well is operating at slightly above break-even due to these extra repair and service expenses. I recommend we shut her down if satisfactory plunger can't be installed.

Harbison-Fischer
'FLEXITE'®
PLUNGERS

are especially efficient in wells making a high percentage of water, hot salt water brine, for high-sulphur-content crudes, or as an all-around plunger for average wells. They are non-corrosive, do not require soaking or pre-fitting, will not swell or disintegrate. Positive seal and free-falling action of rings are effected by built-in inner tension of the hard, fabric-reinforced plastic composition and H-F step-cut design. Each ring is impregnated with graphite for self-lubrication. Available in 20- to 60-ring lengths for all A.P.I. size pumps through leading supply stores in all major areas.

*New catalogue supplement on additional line of H-F pumps is currently available. Ask at your supply store or write us at Box 64, Ft. Worth, Texas.*

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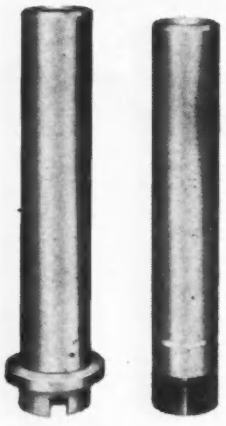
Sub-Surface
PUMPS

*a pump for every producing condition*

HARBISON-FISCHER MFG. CO.
General Offices and Manufacturing Plant — FORT WORTH, TEXAS

DRILLING EQUIPMENT MFG. CO.
DEMCO
OKLAHOMA CITY, OKLA. U.S.A.

SUPER-FINISH
WASH PIPES



A product of years of experience, engineering know how and skilled workmanship, made from special alloy steel, uniformly heat treated inside and outside to absolute maximum hardness, precision machined under exacting tolerances to specifications. Exclusive finishing process provides a mirror smooth abrasive resistant surface which reduces friction and lengthens life of both the wash pipe itself and the packing.

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Houston, Texas ..... Crenshaw Sales Co.
Bakersfield, California
Ed. W. Plaugher & Assoc.
Bakersfield, California ... Ted Waltimire
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Edmonton, Alberta, Canada George Field
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OKLAHOMA CITY, OKLA.

## SQUEAKS from the BULLWHEEL

**Proof**

"He says I don't know how to dress, huh. Tonight I'll wear my low cut dress—and show him a thing or two!"

**Famous First Words**

A mother (entering room unexpectedly), "Well, I never—"

Daughter: "But, Mother, you must have!"

**Ditto**

A Texan walked into the bar of a New York night club, saw a customer lying helpless on the floor, and pointing to him, said:

"Give me a shot of that."

**Saccharine-ized**

Probably you have heard of the young girl who declared she'd never have a sugar daddy. She couldn't stand the thought of old age creeping up on her.

**Remains**

"Mom, is it true that we came from dust and we'll return to dust?"

"Yes, dear. That's what the Bible says. Why?"

"Cause I just looked under my bed and there's somebody there, either goin' or comin'."

**Numb Number**

"I feel a hell of a lot more like I do now than I did when I came," said the blonde at the cocktail party.

**Foresight or Hindsight?**

"Say, what's that crawling on the wall?"

"A lady bug."

"Gad! What eyesight!"

**Way of All Flesh**

Then there was the papa bird who told the mama bird: "How can you beat it? Just about the time we get a nest egg laid away, more bills accumulate!"

**Switch**

Then there was the man who stepped up to the bar very optimistically, and two hours later went away very misty optically.

**Not Sure-Fire**

Officer: "You interested in a commission?"

Recruit: "No, I'm not too good a shot. I'd rather work on a straight salary."

**Technocracy**

America is truly a land of opportunity. The farmer used to blow out the gas, but now he steps on it.

HOW LONG IS A TEXAS MILE?

As long as you choose to make it! By auto, 80 seconds — by Trans-Texas Airways twin-engine 21-passenger DC-3 Starliner, only 20-seconds!

You can't measure the comfort and economy you'll enjoy on Trans-Texas Airways' fast, conveniently scheduled flights. Starliners serve more than 30 Texas cities and four border points with the finest air service — passenger, air mail and air freight.

Next time you plan a Texas trip . . . fly the route of the Starliners!

For information, call Trans-Texas Airways or your travel agent.

ROUTE OF THE STARLINERS

Travel time-tested
Trans-Texas Airways

TRANS-TEXAS Airways

# What's NEW

In Perforating, Testing, and Fishing Tool Services

McCULLOUGH®
NEW SERVICES • NEW TOOLS
NEW WAYS OF DOING THINGS

*Latest News About New Tools, Techniques and Services*

## Announcing the NEW

# McCULLOUGH RADIATION WELL LOGGER

## for Better Gamma Ray Logging

### Featuring Accurate Logging of THIN Beds with a NEW METHOD of Detecting Radioactivity!

Accurate logging of even the THINNEST beds in your well is now possible. This means that beds from 12 feet down to one foot and even less, can be accurately located and logged for the first time!

Sharp logs with high peaks, more breaks, straighter sides, greater definition, and more definite markers have been produced with the new McCullough Radiation Well Logger. Some of the most difficult zones in Texas and California have been logged with outstanding results in the last 12 months. New, thin producing zones have been located—zones that had formerly been missed completely! These logs by actual comparison, are SHARPER than an S.P. or Resistivity log, although made through several strings of casing!

All this is made possible by the use of a radically NEW METHOD of detecting radioactivity—the McCullough Scintillometer.

#### McCULLOUGH SCINTILLOMETER

It was formerly thought impossible to decrease the length of the counter and at the same time increase its sensitivity. It has been acknowledged that IF such a counter could be developed, a sharper, more accurate log would result.

In order to get such results it was necessary to depart from usual methods of detecting gamma ray radiation. The counter in the new McCullough Radiation Well Logger is the McCullough Scintillometer—a solid counter. Because of its high density it is capable of detecting practically ALL gamma rays striking it. It is shorter in length than the radius of any hole it may be run in, yet it is a great many times MORE sensitive than any counter of equal length.

The McCullough Scintillometer is not electrically excited. Measurements made are independent of electrical leakage and only radioactivity is measurd.

This extremely small counter permits logging even the THINNEST beds at their TRUE radioactive level. Base of the break on the log IS the base of the bed—thick or thin.

The supersensitivity of the McCullough Scintillometer permits considerably greater detail in the completed log, since:

1. Its efficiency is close to 100%.
2. It is equally sensitive to high and low energies, yet it does not record meaningless counts (No background radiation).
3. The high count rate, increased running speed, and decreased time constant gives less drag or lag at formation edges.

#### AVAILABILITY

The McCullough Radiation Well Logger is now available in Texas and California. Other instruments are in production and will be made available in all other areas as fast as we can obtain necessary supplies and equipment. Contact the McCullough Service Engineer in your locality for latest information.

#### EASIER, MORE ACCURATE INTERPRETATION BECAUSE:

1. Thin beds are logged at their TRUE radioactive level.
2. A greater detailed log although run two to three times faster.
3. Curves produced contain more breaks, greater definition, more definite markers.
4. Original log is sharper than an S.P. or Resistivity log.
5. Original log DOES NOT need retouching or redrawing.
6. It is calibrated in International Units permitting quantitative measurements of radioactive radiation.
7. Since it has no instrument or temperature drift, it can be used as a future reference tool.
8. It records an extremely broad band of radiation waves, and only part of the band can be measured if desired.
9. It has located new producing zones where other methods had failed to record.
10. Only radioactivity is measured.
11. It does not record meaningless counts (No background radiation).
12. Collar log made simultaneously.
13. Correlates more accurately with electric logs.
14. Counter is not energized by electrical power, eliminating unknown counts due to electrical leakage.

**PERFORATING, TESTING AND FISHING SERVICE ANYWHERE — ANYTIME!**

**McCULLOUGH TOOL COMPANY**

5820 South Alameda Street, Los Angeles 58, California
405 McCarty Street (P.O. Box 2575) • Houston, Texas

**CANADA:** Edmonton, Alberta • **EXPORT OFFICE:** Los Angeles, California
**VENEZUELA:** United Oilwell Service Co., S.A.; Caracas, Anaco, Maracaibo

SERVICE LOCATIONS: **TEXAS:** Houston, Snyder, Alice, Cisco, Corpus Christi, McAllen, Odessa, Tyler, San Angelo, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guymon, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **WYOMING:** Casper: **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **COLORADO:** Sterling.

IN REVIEW . . .

Some of the Best Liked Original Cartoons from Past Issues of the Mid-Continent NEWS

MID-CONTINENT
Supply Company
General Offices Mid-Continent Bldg. FORT WORTH, TEXAS


## SQUEAKS FROM THE BULLWHEEL

"Benson is responsible for the maintenance of all pipe!"

### The Way People Are

The fellow who says, "It goes without saying," goes right ahead and says it anyway.

•

When people get up early in the morning, it's really a triumph of mind over mattress. If it's any comfort, it has been observed that few things are so closely connected as "Getting up in the world" and "Getting up in the morning."

•

Draw your own Analogy Dept.: One reason why the big apples are on top of the basket is that a lot of little apples are holding them up there.

### Talent

"My wife can talk for hours on any subject."

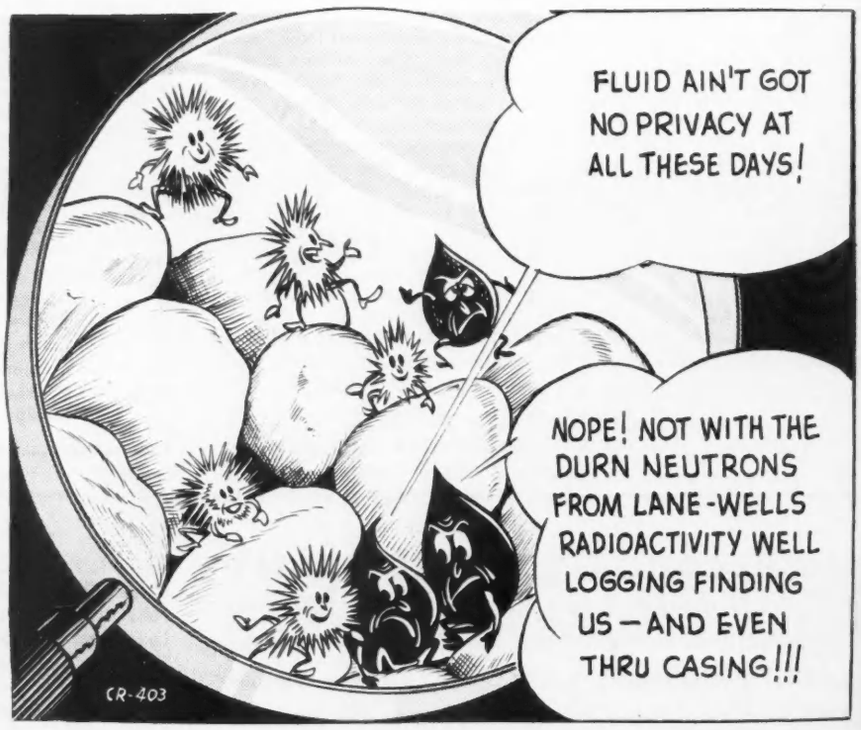
"My wife doesn't need a subject."

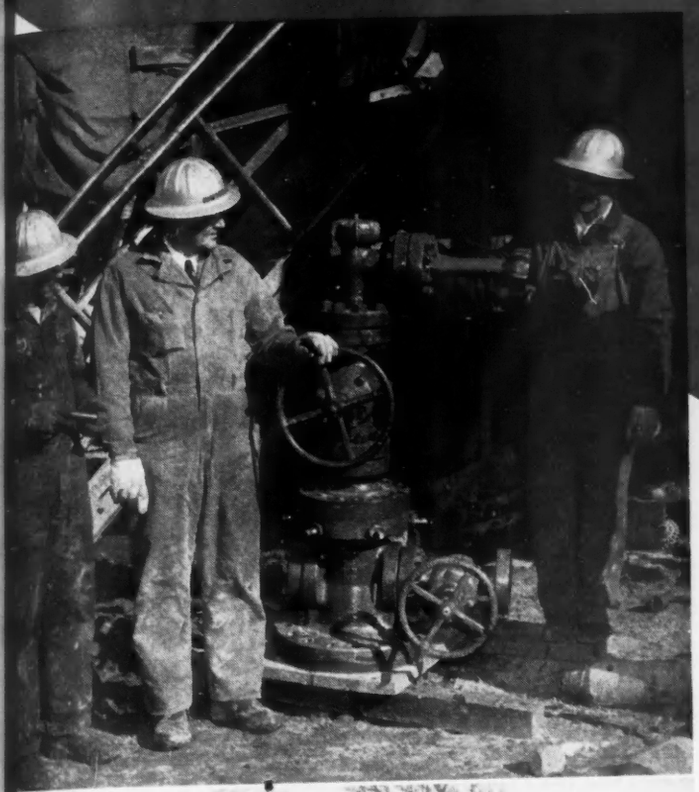
### Strategy

The confident golfer teed his ball, looked far down to the next green, and remarked to his caddy: "That's good for one long drive and a putt."

He viciously swung the driver, tore a sizable hole in the sod, and managed to move the ball a few feet off the tee.

Stepping forward, the caddy handed him the putter and said: "Now for a whale of a putt."


FLUID AIN'T GOT NO PRIVACY AT ALL THESE DAYS!
NOPE! NOT WITH THE DURN NEUTRONS FROM LANE-WELLS RADIOACTIVITY WELL LOGGING FINDING US — AND EVEN THRU CASING!!!
CR-403



"Better Built"

# HINDERLITER TREES

All the features of design and performance that have made the name Hinderliter stand for better Well Head Control Units are available in Hinderliter Trees.

Regardless of your drilling and production practice, pressure, or size of well a Hinderliter *"Better Built"* Tree will provide more versatility from start to finish. It will require few changes, provide greater safety, and can be installed in less time.

In most instances various components of the head assembly can be moved from well to well, as they change from flowing to pumping production.

HINDERLITER PORTER "Better Built" EQUIPMENT

For your next well order a Hinderliter "Better Built" Tree

*Through your* **SUPPLY STORES**

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*Says Scottie "Hopalong" McBlock, I'm built for hard pulling and holding a tight rope.*

**McKissick Peerless SNATCH BLOCK**

Built for a large range of sheave sizes and capacities. Gives you more work power, for large or small jobs.

Shells rounded, sheaves bead encircled to prevent rope jamming. Drop forged hooks swing and swivel. Roller bearings or bronze bushings.

McKISSICK BUILDS A BETTER BLOCK FOR EVERY PURPOSE

**McKISSICK**

McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma


## SQUEAKS FROM THE BULLWHEEL

### Blame the Bugs

He was a milkman with a sense of humor. "Why are you so late with our milk, this morning?" asked the elderly lady.

"Well, you see, mum," he answered, "it's like this. The law allows us 25,000 bacteria to the gallon, and you wouldn't believe how long it takes to count the little beggars."

### So . . .

A cub reporter had one bad habit. His stories were too wordy. Warned to cut them short, he reported an accidental death as follows: "J. Taylor looked up the elevator shaft in the Blank building to see if it was on the way down. It was. Age 48."

### Good Enough

Explaining why he had stayed on in Casablanca after the end of World War II, the ex-GI said he found himself a girl friend who was Free, French, and—unoccupied.

### Anthem

My auto, 'tis of thee, short cut to poverty—of thee I chant. I blew a pile of dough on you three years ago, now you refuse to go—or won't or can't. Through town and countryside I drove thee full of pride; no charm you lacked. I loved your gaudy hue, your tires so round and new—now I feel mighty blue, the way you act. To thee, old rattlebox, came many bumps and knocks; for thee I grieve. Badly thy top is torn; frayed are thy seats and worn; the croup affects thy horn, I do believe. Thy perfume swells the breeze, while good folks choke and sneeze, as we pass by. I paid for thee a price, 'twould buy a mansion twice; now everyone yells "Ice!" I wonder why. Thy motor has the grippe; thy spark plug has the pip, and woe is thine. I, too, have suffered chills, fatigue and kindred ills, trying to pay the bills since thou wert mine. Gone is my bank roll now; no more 'twould choke a cow, as once before. Yet if I had the yen, so help me John—Amen! I'd buy a car again and speed some more.—Bay City Motorist.

### One Run, One Hit, One Away

There was a man who fancied,
By driving good and fast,
He could get his car across the track
Before the train came past.

He would miss the engine by an inch
And make the train crew sore
There was a man who fancied this,
But—there isn't any more!

"Okay, go ahead—but I warn you, he hates to be disturbed."

### Stung

"You say you come from Detroit; that's where they make automobiles, isn't it?"

"Yes, and they make other things there, too."

"I know. I've ridden in them."

### 'Owl of a Note

A cockney and his American friend were walking down the street of an American town one night, when an owl set up his ancient Who-o-o! Who-o-o!

The Englishman asked: "What is that?"

"Oh, that's an owl," answered the American casually.

"Well," stormed the insulted Englishman. "I know it's an 'owl. But what is it that's 'owling?"—Exchange.

### Terrible Drop

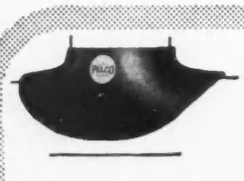
"Did you hear about Gladys?" She has a position as detective in one of the big department stores."

"Well, I don't envy her. Imagine being known as a plainclothes woman."

### Wrong Covering

Young bride: "Please, could you tell me where I could get some silk covering for my settee?"

Floorwalker: "Two aisles down, lady, for the lingerie department."

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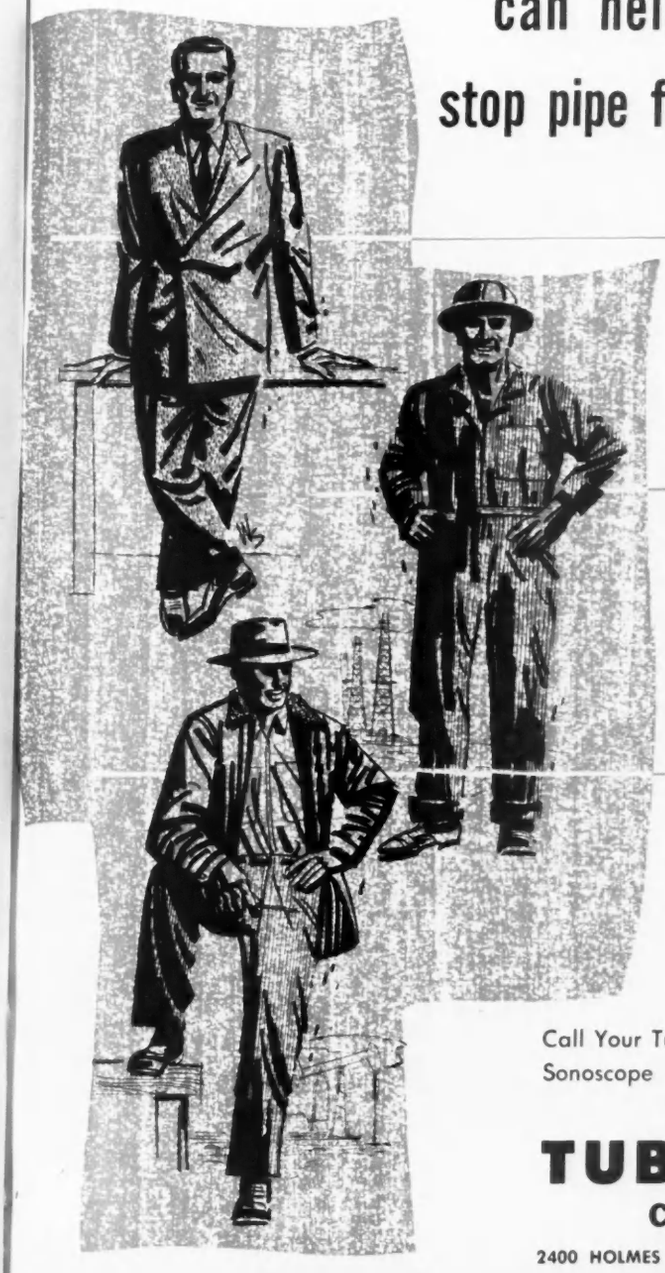
## Which man are you? here's how Tuboscope can help you reduce drilling costs — stop pipe failures — cut production expenses



**MANAGEMENT** "With Sonoscope inspection we know we're getting full use out of each length of drill pipe. And the more footage we can get from each length the more we save. Then, too, the chance of twist-offs is almost nil, and that means less expense from downtime. Our cost per foot now is actually down from what it used to be, even with the generally rising cost of doing business."

**DRILLING** "We add on drill collars and then open up on the speed. It's the only way to make time. Drilling fast like that you can't guess at pipe. That's why we Tuboscope our new pipe for mill defects, and of course, Sonoscope our used pipe regularly. It pays off in faster drilling, no downtime for twist-offs and fishing. And I don't get eaten out for being behind schedule. We use Tube-Tectors, too, because they don't move on the pipe."

**PRODUCING** "We know from our Tuboscope inspection that the tubing and casing are good when they're first run in the hole. They can tell us, too, the exact condition of the inside of the tubing in the well, fast and without killing the well, with caliper surveys. When we do pull tubing we know which lengths to keep and which to scrap. Tuboscope's complete wire line services keep our wells flowing at lowest cost and with least downtime."

Call Your Tuboscope Man Today for the Full Story
Sonoscope - Tuboscope - Tube-Tector Pipe Protectors - Wire Line Services

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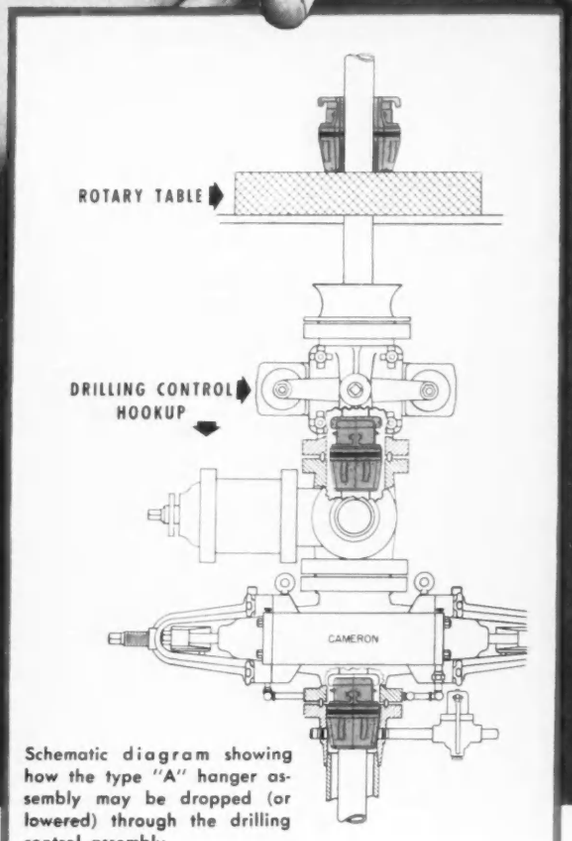
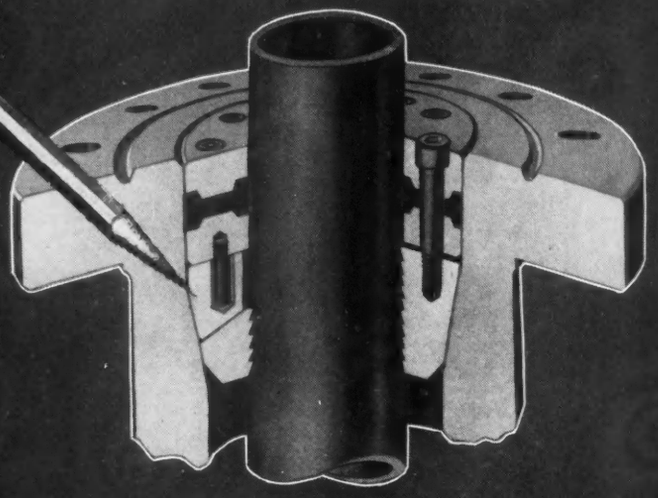
# A for AUTOMATIC — and to spell SAFETY in setting pipe!




Schematic diagram showing how the type "A" hanger assembly may be dropped (or lowered) through the drilling control assembly.



Cutaway view of hanger in place, after removal of setting guide. Note wedges provided in slips which travel inward and upward upon contact with casing head to exert sealing compression on the packing ring.

Hanger assembly in unlatched position.

Hanger assembly in closed, or latched, position.

**Simply wrap, latch, and drop. The Cameron Type "A" Casing Hanger seals automatically — it never forgets. There's no chance for human error. The instant the hanger seats in the casing head and the pipe is suspended, the seal is made *automatically*. The preventers may be lifted without danger of a blowout between casing strings.**

**Installation is simple. The hanger assembly is either dropped through the rotary and preventers to its seat in the casing head, or it may be fastened to the pipe by means of set screws and lowered into the casing head while running pipe. A setting guide prevents the hanger from becoming "cocked" on the pipe when it is dropped through the preventers.**

**Interested operators are invited to write for complete details on the full line of Cameron Forged Steel Well Heads, or see the Cameron section in the new Composite Catalog of Oilfield Equipment.**

Cameron 1st *name in drilling control*

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